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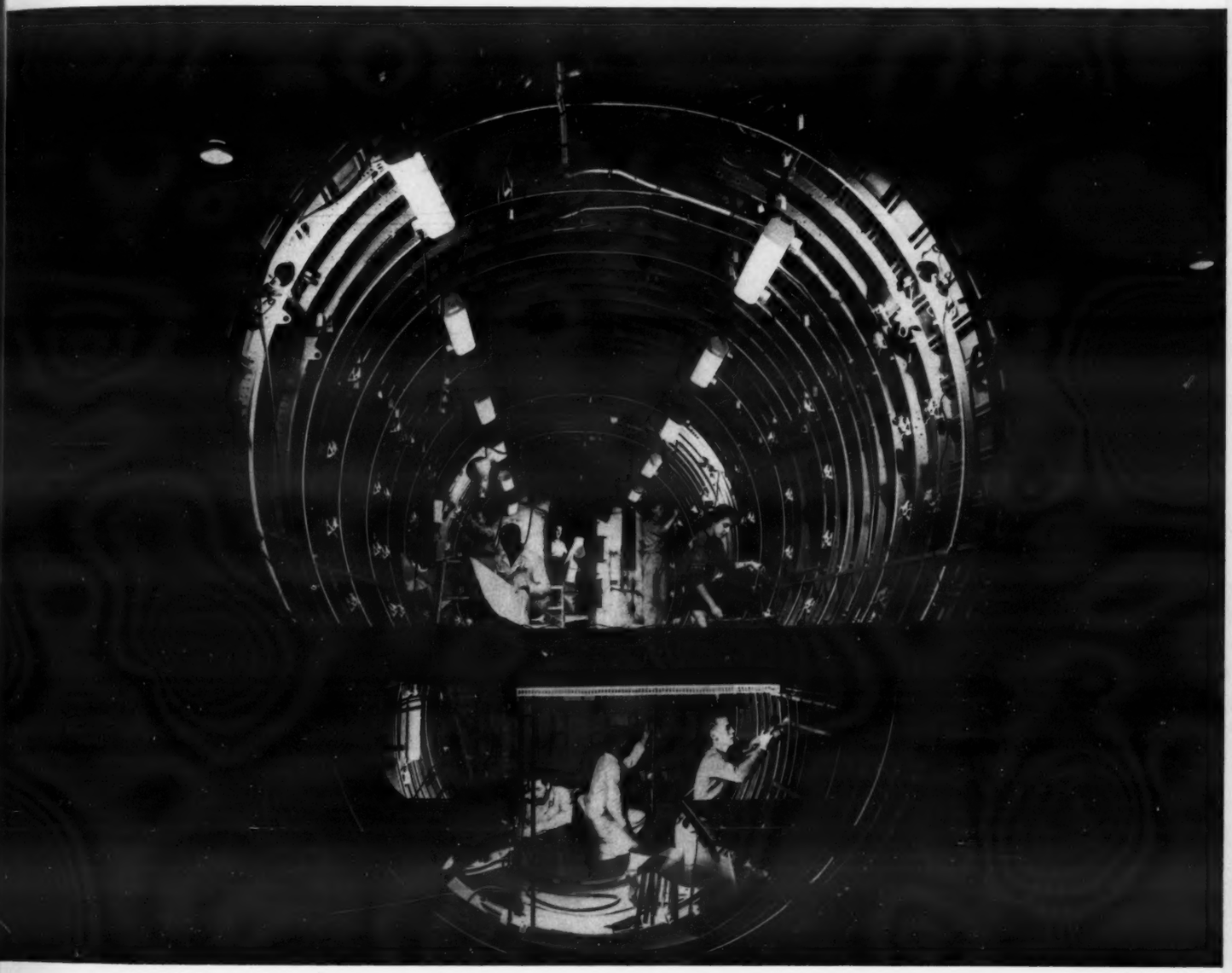
Review of World Aviation



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Helicopter Pilot School — FIDO versus Fog

Aviation Centres on Brussels Again

VOLUME II Nº 6 JUNE, 1947

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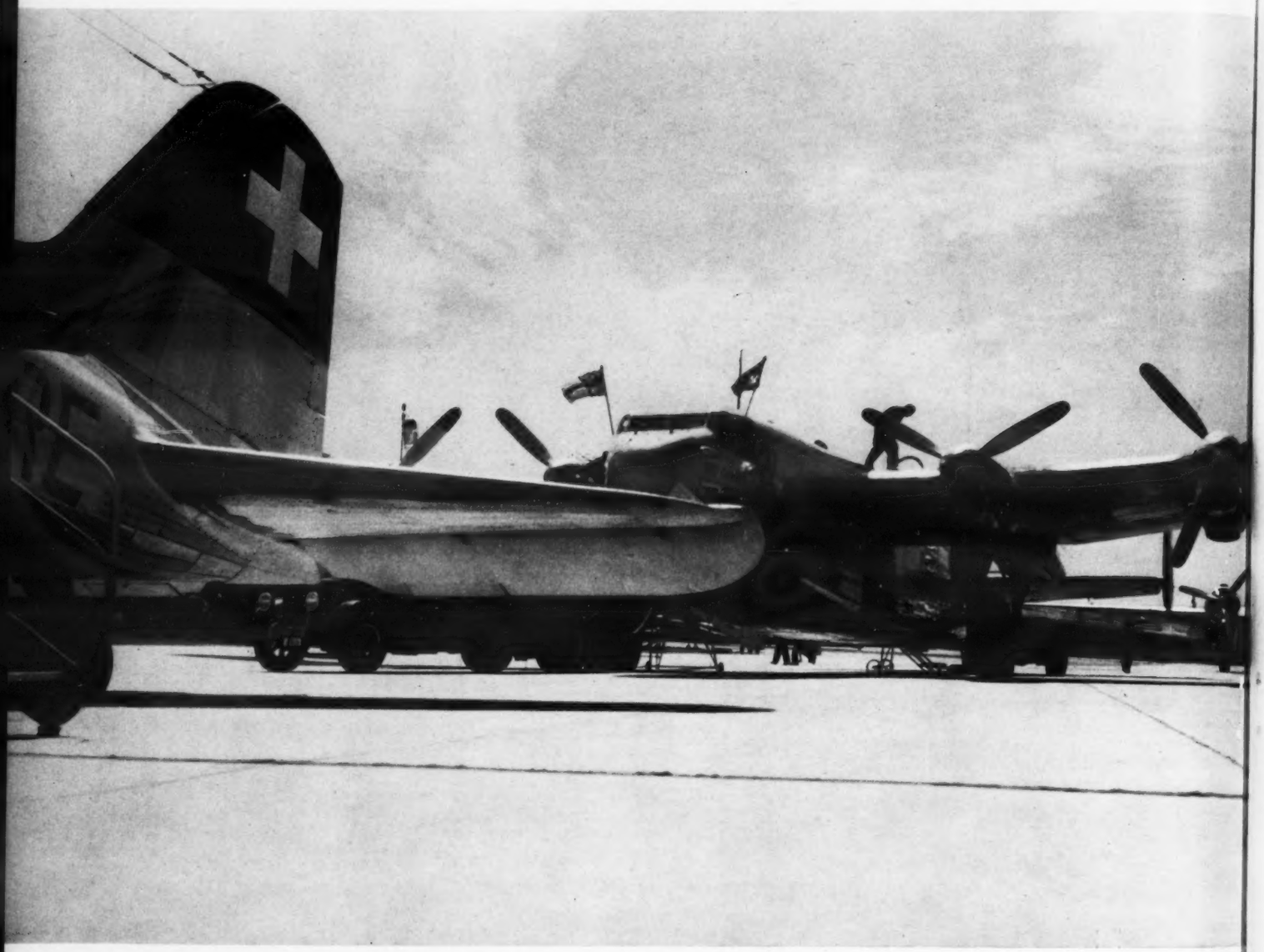

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OFFICIAL ORGAN OF THE FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE (F. A. I.)

Volume II June, 1947 No. 6

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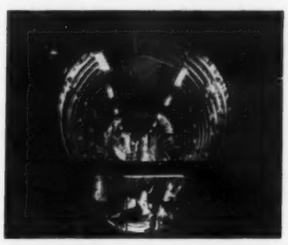

Front Cover :
Boeing "Stratocruiser" under construction

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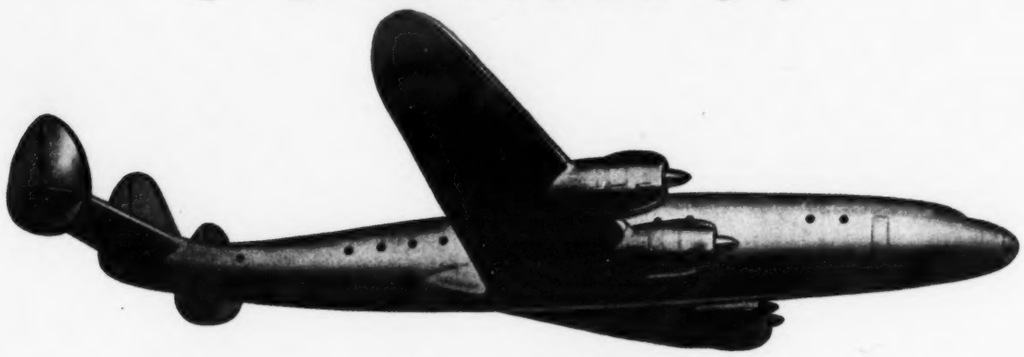

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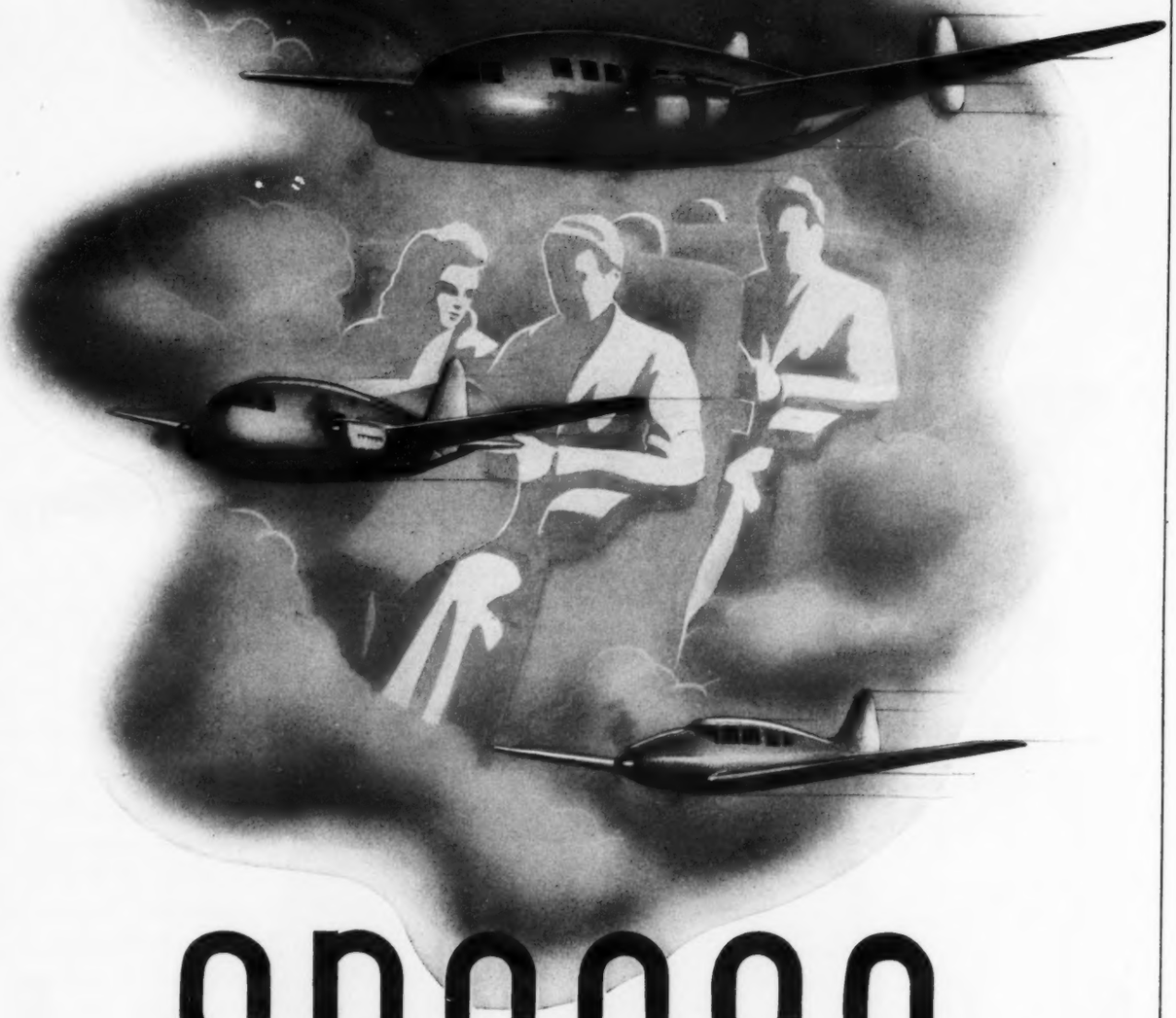

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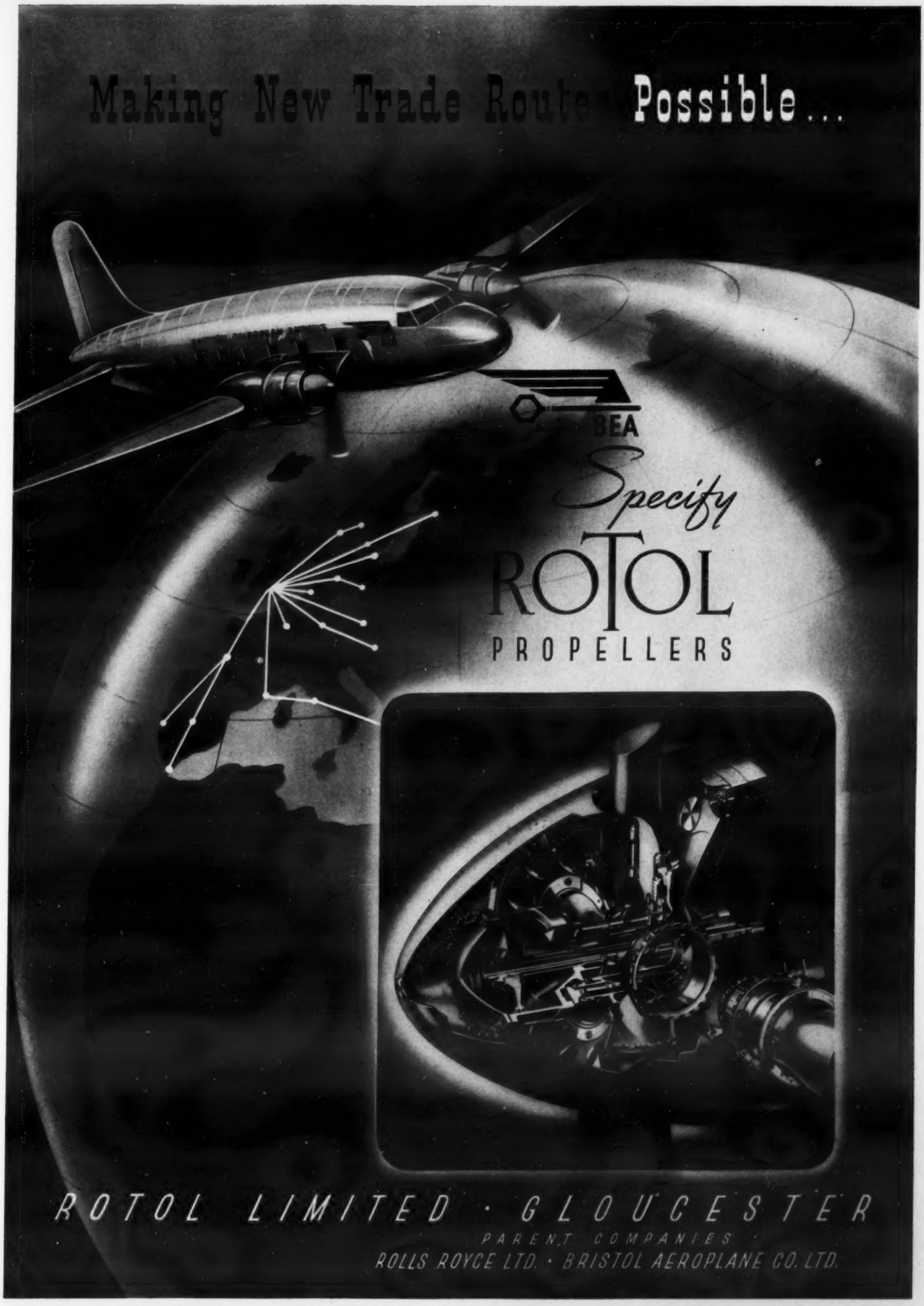

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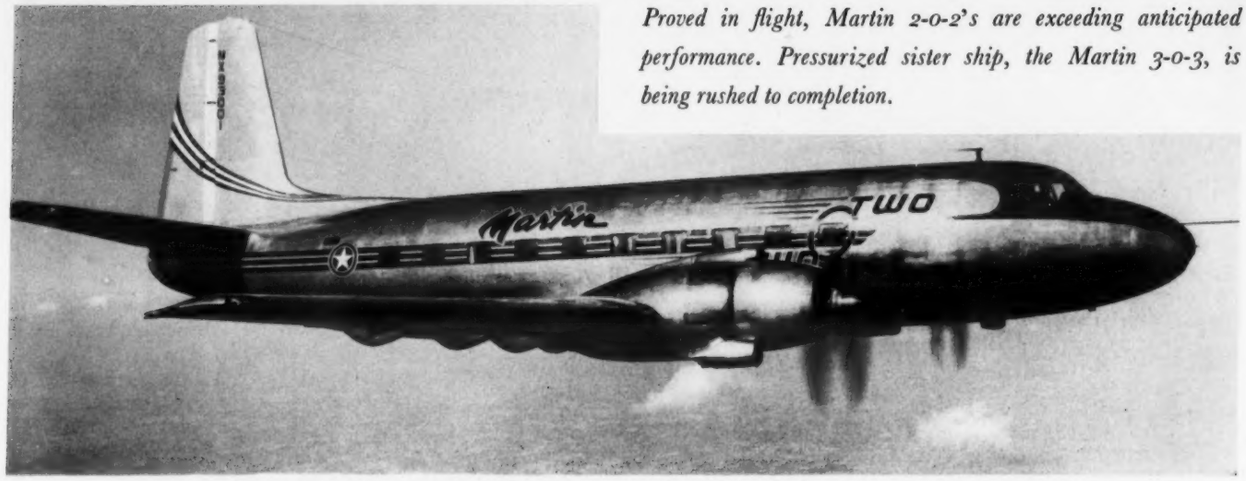

Proved in flight, Martin 2-0-2's are exceeding anticipated performance. Pressurized sister ship, the Martin 3-0-3, is being rushed to completion.

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The Glenn L. Martin Company, Baltimore 3, Md., U. S. A.

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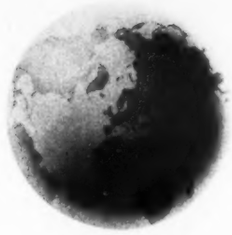
Marginal Notes



Something's wrong...

We maintain all along the line that the American aviation industry is to be regarded as the barometer, the true reflection, of the aeronautical activities of the whole world. Notwithstanding the fact that last May high-ranking American personalities opined that their national industry was only playing third fiddle to Russia and Great Britain, we are still right in our statement. This latest opinion in America is neither derived from an inferiority complex nor from undue modesty. It is propaganda with fixed aims. Below the surface the Americans are absolutely convinced of the superiority of their constructions, their flying equipment and their airline operations ; and rightly so.

This is briefly how matters stand : last May bomber units of the U. S. Army Air Forces gave a demonstration over New York, ostensibly to give the inhabitants an idea of the danger of a concentrated attack on the heart of American business life. Of the 135 Boeing B-29 "Superfortresses", only 101 (by no means in strict formation) reached the target. The American High Command attributed the failure of this manoeuvre to inadequate training of the crews and the fact that the aircraft were obsolete. How do we know that this failure was not intentional ? Looking at it from another angle it is obvious that, concurrent with this simulated attack on New York, the leaders of the U. S. aircraft industry were carrying out a real attack against the responsible Government authorities in Washington. If the U. S. Government does not soon place a few substantial Army and Navy contracts, the aircraft factories will have to close down. During the 1946-1947 fiscal year the contracts placed included only 1,330 military aircraft, and the USAAF contracts for the coming year include, for the present, a mere 932 units—and this after 96,000 war planes had been produced by 14 major firms in 1944-1945, the last year of the war. Quite rightly, the State is being blamed for this shrinking process. Early postwar hopes of a great market for commercial transports and a rush on personal aircraft were due to be crushed in their infancy. The airline companies turned out to be exigent customers and not always easy to please. Even if Lockheed managed to sell 500 "Constellations" at a unit price of about $ 850,000, or if Douglas succeeded in obtaining contracts for a similar large number of his four-engined DC-6's, it would not mean that they had done really lucrative business with the airline companies. And firms like Consolidated Vultee and Glenn L. Martin are already coming to the conclusion that only series of at least 300 units of their new twin-engined types would be profitable. On the other hand, it looks doubtful whether the world's airline companies can yet permit themselves to order and pay for such series. Again, if you want to risk your shirt on personal aircraft construction, you'd better listen to North American Aviation and Piper Aircraft Corp. first. After producing 1,100 of their "Navion" tourers, selling 850 of them at the losing price of $ 7,500 each and not being able to find customers for the remaining 250, North American Aviation decided to stop further production. Piper Aircraft Corp., who until recently seemed to be doing pretty good business in this line, have temporarily had to close down ; the best they can hope for is to open again on a reduced payroll.

However, although big industrialists like Donald Douglas, of the Douglas Aircraft Co., or Robert Gross of Lockheed's, seem to be threatened with a forced close-down next year, these threats are not to be taken altogether too seriously. The American Government would never countenance such an occurence ; it would place contracts in good time in order to keep the core of its aircraft industry alive in peace-time too. It cannot allow a repetition of events which would necessitate spending billions of dollars to start a war-time aircraft industry from scratch. And the opinion of certain strategists that the outcome of a future war will be decided solely with robot space weapons loses its significance in the face of reports from Moscow that the Russians are building the *world's* fastest jet fighter.

Thus it looks as though last May's "industrial attack on Washington" will not have been in vain. Hopes are centred on the establishment of an Air Policy Board which, despite all Budget slashes, would guarantee an annual production in peacetime of three to five thousand military aircraft. It is the only way in which the factories can be kept alive. All the same, the question still remains as to whether some of the fourteen leading wartime concerns could not be grouped together. There is no doubt that payrolls of 20,000 and more, such as those of Douglas, Lockheed and Consolidated, will have to be cut down gradually during the next few months ; and that only the top technicians can be sure of keeping their jobs.

An industry which has only just emerged from its peak period is today working at a loss. In 1946 Lockheed's lost around 21 million dollars ; for the first quarter of the current fiscal year Douglas reports a loss of about 5 million dollars. "If the State doesn't step in fast, the aircraft industry is doomed," are the words on every tongue.

But State assistance cannot and will not be found lacking : not only in the form of contracts for up-to-date jet planes, but also in the shape of a great demand for more modern, bigger and faster troop-transport aircraft. The development contracts awarded to Lockheed (Constitution), Boeing (C-97), and Consolidated (C-99) will be followed by serial orders which will also be beneficial to the commercial aviation of tomorrow. This is no longer something just to be hoped for ; this is a definite promise.

It may seem odd that the American aircraft firms are having to fight to keep on their feet, while, at the same time, the airline companies of the U. S. A. and numerous other countries are short of aeroplanes. But just as odd are the facts that the British aircraft industry seems to be working well, that the French are gradually getting on their feet again in this field, and that the Russian aircraft industry is working at top speed. The same circumstances exist in every walk of life : on any street in New York, London, Paris or Berlin, you will find an excess of buyers and a lack of wares on the one hand, and just the contrary on the other.

Summed up, the U. S. aircraft industry is not only a true reflection of the world's aeronautical activities, but of world trade in general. Something's wrong ! We ought to have a World Clearing House, a means of creating some sort of equilibrium in business. In the wake of today's somewhat opaque world politics, the U. S. aircraft industry is leading an existance which, when we view its size, scientific importance and capacity, seems to be undeservedly difficult. Something's wrong . . .

EEH.

Aviation Centres on Brussels Again

The IIIrd International Aeronautical Exhibition, from July 4th to 20th, 1947

"Small nations can also put great ideas into practice, provided they have the necessary determination and strength." In these terms Major Georges Nélis, one of the creators of the Belgian Air Force and pioneers of Belgian civil aviation, appealed to his compatriots. The Belgians took his words to heart and their subsequent painstaking efforts during the inter-war period have won them a high position among the world's airfaring nations. The first show in Brussels, which took place in May, 1937, was made possible by private enterprise. For the second international show, from July 8th to 23rd, 1939, visitors flocked to Brussels from all parts of the world. The aircraft industry of the Western Powers did not fail to show a lively interest in the efforts of this small kingdom on the North Sea, and contributed to the show with well-equipped stands. At the opening banquet on July 8th, peace was on every tongue, but war was in everybody's thoughts. Germany, represented by General Milch, then Secretary of State for Air, was cunning enough merely to send a Bücker trainer group, whilst England blithely showed her cards by appearing with "Wellington" bombers and "Hurricane" fighters. Poland decided at the last minute not to attend, "in view of the political situation."

Major Georges Nélis, founder of Sabena.

The show catalogue contained the following words :

"The IInd Aviation Show in Brussels is opening its portals at a moment when world peace is being threatened from all sides... Visitors to the Palais du Heysel between July 8th and 23rd will be astonished by the great quantity of military flying equipment exhibited by all countries of the world and by the never-ending progress achieved in this field. In that spirit of brotherhood which has always characterised the relations between flyers of all nationalities, visitors will see the menacing instruments of attack and defence of all countries standing peacefully side by side . . ."

And then followed the long period of darkness, interrupted thrice daily by the repeated refrain of the Belgian radio announcer from London :

"Chaque jour vous dit une voix très proche : Courage . . ." And with commendable courage and fortitude, Belgium has begun to rehabilitate her aviation industry. Once more Brussels is extending invitations to the world —this time to the IIIrd International Salon, which is to take place in the Halle du Cinquantenaire from July 4th to 20th, 1947. The Royal Aero Club of Belgium is adding to the show by organising an international air rally on July 6th.

The Family Album.

Belgium has been "in the picture" from the start. The names of Belgians have figured in all the accounts of international private flying events since 1908. The name of Yan Olieslagers, "the Flying Demon of Antwerp," was never omitted from the list of participants in any international competition before the first World War. Holder of numerous speed and endurance records, he was one of the leaders of that young generation of flyers which paved the way for aviation of today.

Among the best remembered are : Baron Pierre de Caters, holder of the first pilot's certificate to be issued by the Royal Aero Club of Belgium ; Henri Crombez, who carried out the first mail flight between Ghent and Brussels ; Jules Fisher, who obtained the world altitude record in 1912 ; and Hélène Dutrieu, one of the first women to fly an aeroplane. Two of the earliest aircraft constructors, it will be remembered, were the brothers Maurice and Oscar Tips. In 1908 they flew their own all-metal biplane which had a three-wheel landing gear and two pusher airscrews—in fact, almost a modern aeroplane.

The late aviation pioneer and racing pilot, Yan Olieslagers.

Thus we turn the leaves of the album. We discover how Captain Edmond Thieffry, a World War I fighter-pilot, pilot Léopold Roger and flight-engineer Joseph Debruycker established the first air connection between Belgium and the Congo in 1925 with the "Princesse Marie José," a three-engined Handley Page transport. They flew over the Chad territory and covered some 5,000 miles in saventy-five days. To Count Arnold de Loos Corswarem belongs the glory of having made the first non-stop solo flight from Belgium to the Congo via Italy, Tripoli and the Tanezrouft desert in a single-seater aircraft.

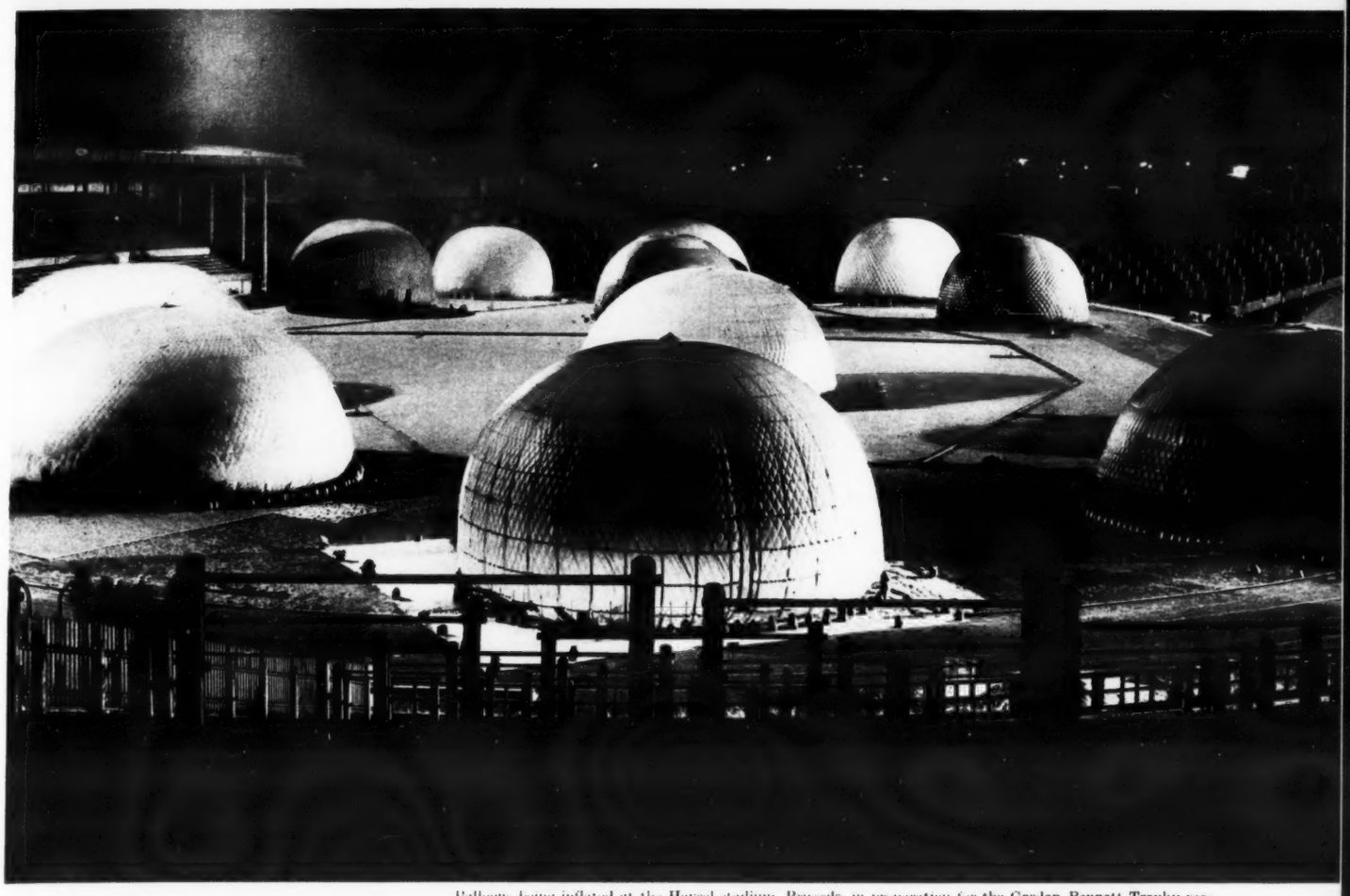
The tablet at Haren Airport, Brussels, commemorating the first flight from Belgium to the Congo.

The names of the balloonists ought not to be forgotten either. In this branch of flying Belgium has always been to the fore. Who has not heard of Ernest Demuyter, five-times winner of the Gordon Bennett Trophy ?

The Hosts.

The Second World War has left perceptible gaps in the ranks of the Belgian exhibitors of 1937 and 1938. All the same we may still find a few old acquaintances listed in the catalogue :

The plant of *SABCA, Société Anonyme Belge de Construction Aéronautique,* which has built around 600 aircraft of different types



Balloons being inflated at the Heysel stadium, Brussels, in preparation for the Gordon Bennett Trophy race.

since its foundation in 1921, was heavily damaged. The rehabilitation process is proceeding slowly but surely.

The Manager of *S. A. Belge des Avions Fairey et Tipsy*, at Gosselies, Oscar Tips, will exhibit a two-seater trainer at the Salon. This firm also figured in the official catalogues of the two earlier shows and built over 300 aircraft between 1931 and 1940.

A new version of the S.V.4 two-seater personal aircraft built by the *Stampe-Vertongen* concern, a plane well-known beyond the Belgian frontier and particularly appreciated in French flying schools, will also be on show in Brussels. Moreover, a special stand will be provided by the *Rénard* firm, the manufacturers of military aircraft closely associated with Stampe-Vertongen.

Tony Orta, Director and General Manager of Sabena.

The battle scars inflicted on the Belgian aircraft industry are not yet fully healed. However, it is hoped that public assistance will be furnished to hasten the cure.

Finally, we come to a participant company which is particularly appreciated by the aircraft industry because it neither builds nor sells aircraft, but on the contrary, buys them : *Sabena*,

Gilbert Perier, Managing Director of Sabena

the Belgian airline founded in 1923 by Georges Nélis, which greatly assisted the Allies during the African campaign, is the first to have recovered from the war. Well in the air again, Sabena provides five weekly connections between the motherland and the Congo, regularly bridges the Atlantic, flies services to nearly every European country, and operates an extensive feeder network in Africa.

Under the leadership of its Director and General Manager, Tony Orta, and of its Managing-Director, Gilbert Perier, Sabena has more than tripled its operating results since 1938. In 1946 three and one half times more passengers were carried than in 1938, and 96,000,000 passenger-miles were flown. On March 31st, 1947, the Sabena payroll featured 62 pilots, 15 navigators, 26 wireless operators, 12 flight engineers, 11 stewards, and 40 hostesses. This may not seem much when compared with American firms. But, as Georges Nélis said after the first World War :

"It only needs determination and strength."

Undisclosed Souvenirs from Henri Farman's Diary

COMPILED BY LUCIEN ADÈS, PARIS

(Concluded)

Slowly, but surely, I began to gather together the threads of reason. During the entire night which followed that eventful day, I thought hard, calculated, and the following morning my mind was made up. Along the strip of wood which limited the movement of the joystick, I made a number of marks—four, if I remember correctly—at roughly calculated distances apart. I revved up the engine and set the stick against the first mark as I taxied forwards. The result was negative, and Voisin, running alongside was vociferous in his urging of me to abandon my absurd idea which, he said, was only a useless

Caricature of Santos-Dumont.

waste of precious time and money. He insisted that I leave the stick as it was. I refused to listen, and went on to the second mark. Really angry with me, Voisin turned his back and walked off towards the hangar.

Meanwhile, however, I was beginning to feel the aeroplane more docile in my hands ; it seemed as though it was lighter and faster. With my heart beating, I placed the stick against the third mark, a voice inside me seeming to say that, for the first time in my life, I was about to fly "scientifically," that I finally had the solution. The aeroplane gathered speed. For the first time, "Antoinette's" fifty-horsepower seemed to have found their freedom, as if pushed forward by the wings and the aeroplane's own momentum. *After covering a few metres, I moved the stick another few millimetres, and was airborne.* My apprehension and hesitation was gone with the wind. I had learned how to fly.

Alarmed by the shouts from all sides of the field, Voisin turned round—just in time to see me flying, not far from him, at fifty kilometres an hour, one and a half metres from the ground.

It had suddenly dawned on him too that we had made a great step forwards.

Now for the Kilometre . . .

After this first jump, our trials were rewarded with more and more success every day. During the summer of 1907 each daily flight I made was a little longer and a little higher.

Then, on October 15th, 1907, after a few modifications to the aeroplane, I made a flight of 280 metres, thus beating the 220-metre record set up by Santos-Dumont with his ultra-light machine of 150 kilogrammes.

The public was wild with enthusiasm at this news, and I had a taste of glory and celebrity.

This is how *Le Matin* of October 16th, 1907, related the story of my exploit :

"The science of aeronautics has made a new 'flight' forward along the path of progress. Monsieur Henri Farman has beaten the record of 220 metres held since November 12th last, by Monsieur Santos-Dumont.

This feat was accomplished yesterday afternoon on the parade ground at Issy-Les-Moulineaux. Although recent heavy rain had caused the ground to look more like a swamp than an airfield, Monsieur Farman did not hesitate—between two showers !—to taxi away from near the Porte d'Issy. As soon as the engine was started, the propeller turned normally. After taxiing about ten metres the aeroplane reacted perfectly to the stabiliser and rose gracefully with the greatest of ease and stability. By manoeuvring the front control surface, the pilot frequently increased his altitude to ten metres, later to fly lower again. In this manner the aeroplane covered a considerable distance, and it was only after repeated appeals by Monsieur Gabriel Voisin that Monsieur Farman finally consented to land, in a thick patch of mud ; thanks to this, the landing was accomplished without the slightest shock. The approximate distance flown was measured : Monsieur Henri Farman had covered about 280 metres . . ."

Santos-Dumont's aeroplane at Issy-Les-Moulineaux.

Mr. Farman decides to buy an "airship."

Levasseur's " Antoinette, " forerunner of many French aero engines.

These convincing results encouraged me all the more to continue my tests. I managed to climb to twelve metres altitude. The press was amazed and wrote :

"Between 150 and 200 metres

It has been achieved. Human beings can now rise from the ground, fly around at will and land without harm. This is amazing progress when compared with the accomplishments of six to eight months ago.

Yesterday, Monsieur Henri Farman accomplished seven glides of 95, 110, 140, 128, 115, 180 and 175 metres distance, at an average speed of nine to ten metres a second. During the sixth flight the aeroplane travelled through a wide curve and the aviator showed no hesitation in passing right over a group of spectators.

The tests were controlled by Messieurs Archdeacon, Santos-Dumont, Surcouf, Delagrange, Max Richard and Lhermit."

On October 27th, 1907, I finally flew for almost a kilometre and on November 10th, 1907, in the presence of numerous witnesses, my dearest desire was fulfilled : a curve. The next day my name was on the front page of every newspaper :

"*A triumphal curve :* Yesterday, aeronautics crossed the threshold of a new era. With the Voisin apparatus in which he beat Santos-Dumont's record two weeks ago, Henri Farman not only covered a kilometre in the air, but furthermore succeeded in completing two majestic curves. All who had watched Farman's efforts from the start were enthralled and are not in the least doubtful that the aeroplane, in the hands of such a capable aviator, will soon be no longer a subject of scientific study, but a new means of transportation.

Henri Farman can be all the more pleased about his great achievement, as it was officially supervised by sharp-eyed gentlemen who had previously measured the field ; and, provided certain conditions are fulfilled, this simple kilometre may earn the aviator the trifling sum of 50,000 francs, to be handed over with pleasure—they told me themselves—by Messieurs Deutsch and Archdeacon.

Take off from a given point, fly around a flag planted at 500 metres from the point of departure and return to at least 50 metres from the starting point, of course without touching the ground, and these two amiable patrons will each present you with a cheque for 25,000 francs . . ."

The "Magic Circle"

As I said beforehand, my aeroplane had no ailerons and the rudder was located between the two wings, preventing it from making any quick and efficacious movement. I used my body for turning nearly as much as I used the rudder. The test stipulated a flight in a closed circle, with a curve around a flag-pole. The total length of the circuit was one kilometre. According to the expression of the day, I had to "describe the magic circle."

It was already winter by the time I decided to try for the Deutsch-Archdeacon prize ; I had been carrying out long trials, more and more thorough and difficult. Many celebrated aviators of the day had preceded me in this attempt ; but the dreaded curve around the flag-pole had always constituted the eliminating factor. Convinced that nothing but bad luck could prevent my succeeding, I invited the jury, witnesses and the press to be present on the morning of January 13th, 1908. It was a clear, crisp winter's day. Certain parts of the Issy ground were frozen. There were not as many people present as one might have expected. Only a few friends and the official personalities attended. There was good old Mr. Deutsch, wearing his legendary bowler hat, Mr. Archdeacon, in a fur-lined cloak and fur cap, Mr. Henri Kapferer, the Comte de la Vaulx, Georges Besançon, who published the "Aerophile," Léon Delagrange, Ch. A. Bertrand and a few other aviation fans. Our little team stood by, waiting nervously.

After a very successful achievement, I believe that the usual thing to say is that it was a foregone conclusion from the start. Well, I have no objection now to confessing, forty years later, that I was well and truly scared that something would go wrong ; not that I had the slightest doubt as to the quality of my machine, but because my calculations contained such a plethora of unknown factors.

Henri Deutsch, wearing a bowler, and Ernest Archdeacon, in a fur cap, who presented the 50,000 francs.

Meanwhile, everything went off just as planned, and the only time I experienced any special emotion was when I passed the white flag and prepared to turn back to the starting point. Half-way through the curve I lost sight for a brief instant of the post which marked the point of departure and

Farman at the end of the circuit.

Henri Farman congratulated by Henri Deutsch de la Meurthe (centre) and Charles Voisin.

"The dream of 1907 — a passenger flight." Farman and Archdeacon flew nearly one kilometre on May 30th, 1908.

arrival. The light mist which shrouded the field had momentarily deprived me of my vision. Guided solely by instinct during those few seconds, I resolutely set course for the point I supposed was the right one. Very slowly, the crowd and the marker post loomed out of the mist. I had completed the circuit, though the curve had been a little wider than was prescribed.

And then followed the glory . . .

All who witnessed the performance were overcome with enthusiasm. If you insist on knowing how I completed the circuit, I would prefer to let Georges Prade, the editor of *Les Sports*, tell the story for me :

". . . The apparatus definitely looks odd. From a distance it looks for all the world like the entry to a large tent. Like some queer animal reclining, it is truly ugly and ungainly ; its slightly cambered linen surfaces give it a tired and dirty appearance. Strangely enough, however, it takes on a graceful aspect when it flies ; then it resembles a gigantic flamingo, or a heron with its legs and beak hanging down ; and it flies as smoothly as an arrow.

I can guess the whereabouts of Mr. Farman by the way in which the police are separating the people. I break loose from the group of spectators and take position on the other side of the field, between the two posts at 500 metres apart, right where the show is to take place. He will start off from one of these posts, fly around the other one, and then return. Everybody is waiting tensely.

There he goes ; the engine is throbbing and he is just about to take off.

The take-off is sudden, violent. It seems that nothing is holding the machine back. It gallops along lightly on its frail-looking wheels, and the bouncing motion imparted to the entire structure give it the appearance of an ostrich, fleeing with outspread wings from the hunters.

And then, almost imperceptibly, the machine rises gently into the air, as though it were travelling smoothly up an invisible slope. The sharp, pitching motion is now replaced by a long, and slow, almost unnoticeable heaving movement ; like a ship riding at anchor. The man has turned into a bird ; he is flying, and has victoriously left the starting post behind him. Nobody is at all nervous. It is uncertainty that makes people nervous ; but there is not the slightest element of uncertainty right now. The man and his machine give such an impression of security that everybody has the new feeling that flying is a perfectly natural function, like walking or swimming. *C'est beau, c'est grand, et c'est simple.* Why is it that nobody else has been able to do it before ?

He has completed the circuit. Calmly, like a gigantic bird, the aeroplane comes to a standstill at the finishing post. A little later, Mr. Farman takes off again to make a wide curve and bring his machine back to the door of the hangar . . ."

American Burlesque

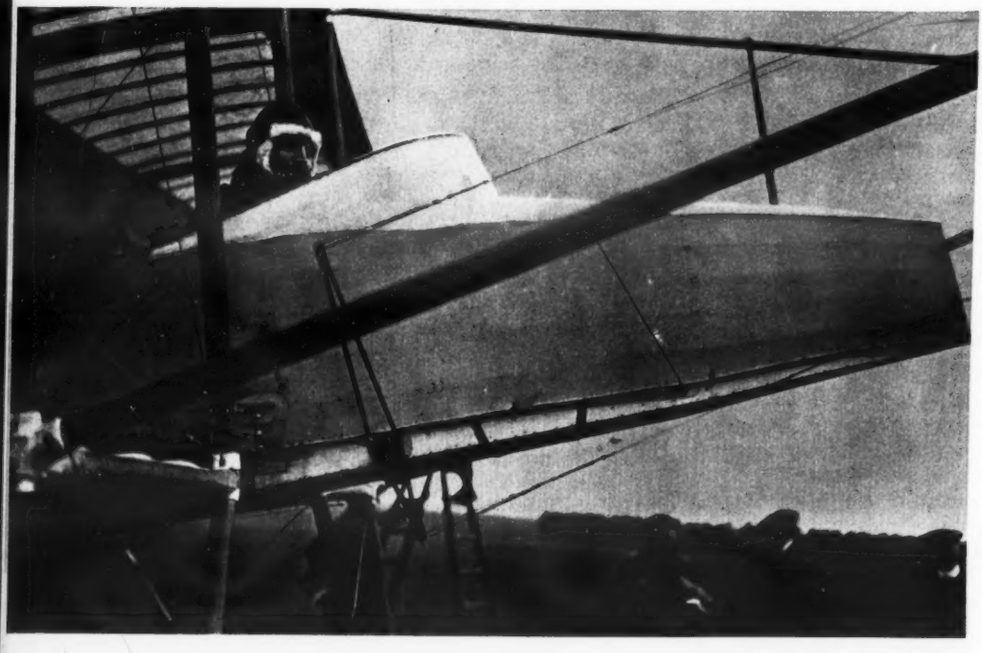
The aftermath of success : the memory is still very dear to me. Official dinners, banquets, intimate celebrations among friends : everybody insisted on throwing a party in my honour ; I was well and truly spoilt. A few days after the event we were celebrating "among aviators" at the Café de Paris and after we had lined up a sizeable number of empties I made a wager—for 30,000 francs, I believe—that before I died I would fly non-stop from Paris to Rouen with a passenger on board.—Such were our wildest dreams.

Offers poured in from all sides ; I toyed with a thousand and one projects. However, I only acceded to one invitation. It was a charming one from an American business man who wished me to give a few demonstrations in the U. S. A. He foresaw a gold-mine in the idea. My arrival was heralded by a huge publicity campaign ; placards showing me flying over sky-scrapers were pasted on nearly every wall of New York. I was received on the dock-side by a number of high-ranking officials and, of course, the inevitable little girl with a bouquet of flowers.

I was completely flabbergasted when I was shown the flying-field. I was nothing else but one of the circus turns at Coney Island. Well, it was too late to back out. My first show was honoured by the attendance of the civic and military authorities. But later on, the public began to show a marked preference for the performing animals and the acrobats. My impressario went bankrupt, and the bailiffs seized my aeroplane. My faithful partner, Hebster, who also acted as my mechanic, helped me to preserve the "Henri Farman I" from the disaster brought on us by this hot-headed businessman. We made a "moonlight flit" and shipped the machine. There was no band playing for the return trip. I never even had a chance of seeing New York, and I have never been to America since.

* * *

After 1909 my progress was meteoric ; and two years later my "famous kilometre" was a hugh joke. Then the first World War broke out. Aviation was to be the object of my every thought and effort for the next thirty-odd years, and was ultimately to become my pride and joy ; like a child to whom I had shown its first sunrise and taught its first steps, and to whom I am afraid today to reveal the future lest it should lose heart.



Aviation With Obstacles

Montreal in the Shadow of World Politics

Paradoxical as it may seem, aviation is always earthbound. In the world of hard facts the ideas of "aviation" and "air traffic" are submitted to many curbing influences, alien to aviation.

The well-known Dutch expert on air law, Dr. D. Goedhuis, in his inaugural address as professor of air law at Leyden University, * gives a striking picture of the barriers which civil aviation has erected in its own path during the short history of its development, and of those which are looming up before it again today. Aeronautical science is at present endeavouring to break through the "sonic barrier." Breaking through these other, wholly unscientific barriers is by no means simpler. Dr. Goedhuis comes to the conclusion that, from the organisational point of view, world aviation has not only failed to keep pace with its technical development, but that a marked step backwards is to be observed. He gives examples to illustrate this opinion. Here is a particularly convincing one : on February 20th, 1928, the countries of the American continent concluded an agreement in Havana, whereby they alienated themselves considerably from the general Paris Convention of 1919 (CINA). The reason : whereas the Paris Convention was a more or less useful instrument for Europe, it was of no use to the American countries, as aviation in the Western Hemisphere was extremely different from that of the Eastern Hemisphere. They maintained that there were no points of contact. However, just before this convention was concluded, Lindbergh demonstrated by his west-to-east flight that certain points of contact were all the same not to be denied.

The organisation of world aviation has continued to develop with similar retrogradation. Each time the technicians took a step forward, the administrators took a step backward. Compared with the Paris Convention of 1919, that of 1929 involved a noticeable decline, as the desire for unlimited power of every individual state has since grown, and the conception of reciprocal dependence has weakened accordingly.

As regards the Chicago Convention it is not to be doubted that much has been stifled of what CINA had developed in the way of freedom in international aviation.

The Fear.

Dr. Goedhuis' pamphlet is more a socialogical than a juridical study. The author endeavours to discover the motives behind this decline in the organisation of world aviation. He declares that the driving force behind the organisation of all commercial flying—or better said, the disorganisation—of today, is fear : fear of competition, fear of the encroachment of foreign political conceptions, fear of espionage, fear of the offensive potential which aviation could represent, fear of the great powers and also fear of the "small ones" ; fear of anything and everything.

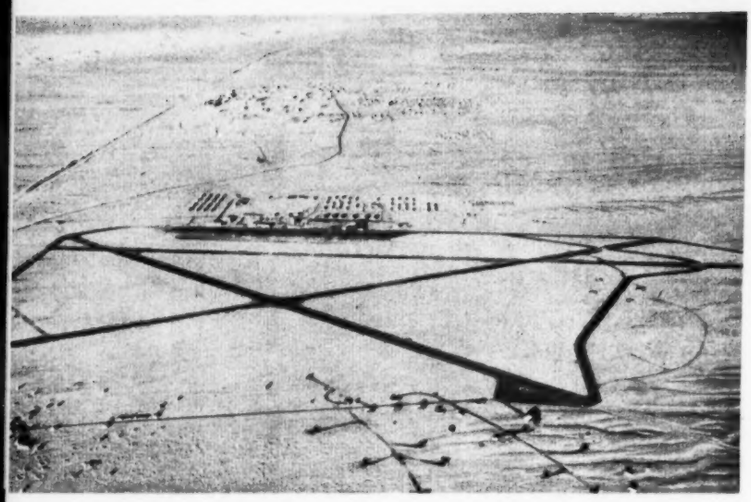
Is it to be wondered that world aviation is ruled by fear ? As we have already said, it cannot prosper under artificially-created optimum conditions ; it must necessarily develop as a faithful reflection of international life as a whole. As international politics are at present ruled by mistrust from all sides, the reciprocal understanding in aviation is accordingly at a standstill. It is interesting to watch how the general development of aviation reflects these trends and how it registers each little political turn. We only need to study the course of the international air routes in east and southeast Europe in order to discover where the tension reigns in world politics.

The Reflection.

American Overseas Airlines are at present conducting regular flights from the U. S. A. to Stockholm. By the time this magazine is in print they will probably have extended their route to Helsinki. But

The projected headquarters of the two international air organisations, on the site of the Central Station in Montreal. The architect's sketch below shows (left) the International Aviation Building ; (centre) administrative headquarters for the Canadian National Railways ; and (right) the proposed C.N.R. Hotel, which is to provide first class accommodation for members as well as extensive banquet and convention facilities. The project will place these two bodies, representing the governments and the airlines, under one roof, thus promoting closer collaboration.

* "Idea and Interest in International Aviation." Published by Martinus Nijhoff, The Hague.



Runways at Farouk Airport, Cairo.

An airport in the focal point of world aviation politics. The administration building of Farouk Airport, Cairo. Originally called Payne Field, the airport was built by the Americans during the war, and handed over to the Egyptians on December 15th, 1946.

there it ends ; and for the present there is no indication whatsoever in perspective of an easterly extension. The Leningrad to Moscow certificate granted by the U. S. Civil Aeronautics Board momentarily remains theoretical. The same applies to the more southern route certificate granted to Pan American Airways. On August 1st, 1946, PAA was authorised to inaugurate a round-the-world route, from New York via London and Brussels and thence by way of Prague, Vienna, Budapest, Belgrade and Bucharest to the Near and Far East. Notwithstanding a great deal of effort, Pan American Airways have so far not been able to operate further than Vienna. In return for landing rights they offered to finance the development of Ferihegy Airport, Budapest ; their offer was declined by the Hungarian Ministry of Transport. Yugoslavia, which can be classed as forbidden territory since the shooting down of Allied commercial and courier transport aircraft last summer, seems to be opposed to any sort of negotiation. Last October, the U. S. Military Authorities in Europe were obliged to forbid PAA to fly over any European territory east of Brussels. As a result this airline company, which is at present most interested in Italian landing facilities, has been flying the England—Karachi leg with only one intermediate stop in Ankara since March 8th this year.

Aeroflot, the Russian airline company, operates its services to the east European States with licence-built Douglas DC-3's.

The traffic position does not look any friendlier if one regards it in an east-west direction. Granted that Soviet Russian aircraft of the Aeroflot company land in Rome and Paris ; but these only involve special and courier flights. It is quite impossible to refer to any kind of scheduled air traffic.

What applies to air route planning also applies, of course, to air political relations. The U. S. A. only needs to conclude an air agreement with Turkey, for the U. S. S. R. to follow suit and ratify corresponding pacts with Iran. If the U. S. S. R. can see its way to an understanding with Hungary, then the U. S. A. will come to terms with Greece. If we examine the list of the thirty countries with which America has so far signed bilateral air agreements, we perceive that not one of the countries of the disputed confines of the eastern Mediterranean is missing : Greece, Turkey, Syria, Lebanon, Iran, and Saudi Arabia.

If Transcontinental & Western Air and British European Airways Corp. countenance a participation in Italian airline operations, and the formation of Anglo-Italian or U. S.-Italian carriers, we may be sure that before long we will hear of a firm whose name combines Latin and Cyrillic characters. On the one hand TWA has shares in the Greek Aero Hellas, the Turkish Devlet Hava Yollari and in the Persian Iranian Airways ; PAA has a working agreement with Syrian Aviation Corporation ; BOAC and BEAC are organising the operations of Egyptian Airways, Middle East Airlines and Iraq Airlines. On the other hand, Aeroflot has the say in Bucharest, Belgrade, Sofia and Budapest. Again, there is no lack of excitement in the separate territories of these three competitors. Colonel C. H. Seager, Chief TWA representative on the Board of Aero Hellas, was destined to find this out by experience. Initially, the Greeks afforded TWA and BEAC a share participation of 22 per cent each. Later on they apparently changed their minds. One fine day they had Colonel Seager forcibly removed from the Aero Hellas offices by the police and began carrying out a new share issue which would place the entire company in Greek hands. A special commission of the Greek Ministry of National Economics

Some French Aircraft Types now in Production

C. 800 GLIDER
Two-seater trainer.

NORD 1200 "NORÉCRIN"
Three-seater personal aeroplane.

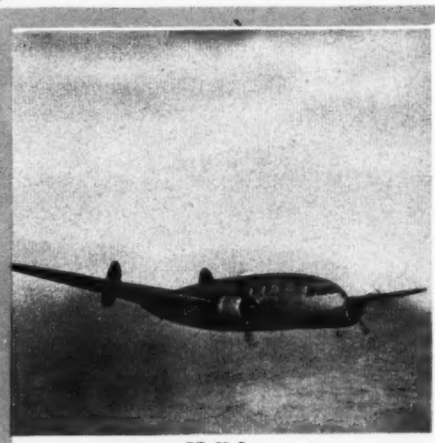
BREGUET 11E HELICOPTER

MORANE-SAULNIER 472
Two-seater fighter trainer.

SUC 10 "COURLIS"
Taxi or personal aircraft.

SO 7010
Taxi or light transport aircraft.

NC 702
Eight-passenger transport aeroplane.



SO 30 R
Modern 30-passenger airliner.

LANGUEDOC 161
Four-engined 33-passenger airliner.

LATÉCOÈRE 631
72-ton flying-boat.

OFEMA

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subsequently ruled that this issuance of stock was invalid, and reinstated Colonel Seager. Meanwhile, incidents of this kind remain characteristic of the tension to which airline operations in southeast Europe are being subjected.

Whereas the Anglo-Saxons are meeting with difficulty in Greece, the Soviet Russians are having to surmount similar obstacles in Iran. At the beginning of last May, Teheran declined a Russian proposition for the formation of an Iranian-Russian airline company, and requested that the Soviets withdraw their aircraft as soon as possible from the airfields in Northern Iran.

A few weeks ago negotiations began in Washington between the British Embassy and the U. S. Civil Aeronautics Board. The two countries are considering a common air policy for the east European zone and wish to conclude identical air agreements with the nations under Soviet influence. They have been able to come to an understanding with Czechoslovakia and Finland ; but it remains to be seen whether south east Europe is prepared to come to friendly terms. It is very doubtful whether the ultimate aim to conclude an air pact with the U. S. S. R. is any nearer to realisation. The Russian Foreign Minister's declaration at the Moscow Conference that the Soviet Union was not yet prepared to discuss air traffic questions is nothing but a repetition of what Stalin himself said in October, 1946. A lengthy questionnaire submitted to him by a United Press representative included the question : "Will Russia permit foreign airline companies to fly over Russian territory ? Has Russia any intention of extending its own air routes to other Continents on the basis of bilateral agreements ?" U. P. forgot that curiosity killed the cat ; for Stalin answered : "Under certain conditions, this is not excluded."

Well, it would not seem that the "certain conditions" have yet materialised. Russia has expressed a desire for air bases in the Dardanelles. Great Britain has supplied Turkey with a total of 500 fighter aircraft, accompanied by R. A. F. instructors. About ten North American P-51 "Mustangs" fighters destined for Turkey land every day at Ciampino Airport, Rome. The British are establishing training centres on Cyprus—at Porphon, Arnauti and Nicosia. And according to an "Izvestia" report, Turkey—who built some 100 airfields under British direction during the war—has placed a $ 4,500,000 contract with Westinghouse Electric Corp. This contract is reportedly for lighting systems for five large airports. The Russian press also maintains that special airports and radio stations exist in Turkey, which are exclusively for the use of the British and Americans. Moreover, the Russians state that the Anglo-Saxons have established an airline network in Turkey, operated by Anglo-American military personnel.

In the meantime, the Americans sent a fleet of their latest aircraft carriers on a training cruise through the Mediterranean.

This picture of the small clouds and big clouds on the horizon of international aviation politics is not yet complete. Besides the Mediterranean there are other disputed areas—the Arctic, Antarctic, Japan and China ; or then we only need to consider the Mediterranean area from the point of view of the Arab League, which, with its Aviation Council, is complicating the picture with transit flight bans, boycotts and joint associations, and is showing just how tasty air transportation can be made when spiced with politics.

A Surprise ?

In aviation politics the spotlight is on Spain and her recent exclusion from the International Civil Aviation Organisation. Sensational as this was, if we consider the matter logically, it is obvious that the delegates must have found it hard to register the surprise which the public expected of them on May 13th. The matter had been thoroughly studied months before the first plenary session of ICAO ; and every delegate knew long beforehand what was going to happen at the opening meeting on May 6th and 7th in the Windsor Hotel, Montreal.

Nor to us, after our brief review of the picture, can it have come as a surprise that, after the appointment of the Chairman (Arthur S. Drakeford, Australian Minister of Civil Aviation) and a number of administrative and technical matters had been discussed, numerous political questions figured on the agenda ; questions which concerned the Mediterranean area.

Italy's application for membership in the Organisation was unanimously approved on May 16th by 31 votes (three members abstaining). But three days beforehand, on May 13th, a point had to be settled, which resulted in the Spanish delegate, E. F. Terradas, jumping up from his chair, rushing off to the cloakroom, grabbing his hat, coat and umbrella, and looking like one bereft of his senses before the press photographers at the door of the Windsor Hotel.

The first act of this little drama is really nothing new. As a matter of fact it was presented in 1944. At that time the Soviet Union had refused to join the Provisional International Civil Aviation Organisation because, among other things, it had no desire to sit at the same conference table as representatives of Franco-Spain. For years a seat on the PICAO Interim Council was kept open for the Russians ; but they remained stubborn. However, the decision of ICAO, PICAO's successor, to exclude Spain, is not officially for Russia's sake. Spain's exclusion, decided on by 27 votes against three (Ireland, Portugal and Switzerland), with two abstaining (Argentina and South Africa), was the desire of the United Nations Organisation. It so happens that the U. N. O. Executive Committee agreed on December 14th, 1946, to collaborate with ICAO under the condition that Spain be struck off the air organisation's roster.

As the Chicago Convention on International Civil Aviation had hitherto only provided for the voluntary resignation of a country, but not that a nation should be dismissed against its will, an amendment had to be drafted.

British bombers over hot areas—the Jordan Valley

After Article 93 was added Article 93 bis, which reads as follows :

(A) Notwithstanding the provisions of Articles 91, 92 and 93, above :

(1) A State whose government the General Assembly of the United Nations has recommended be debarred from membership in international agencies established by or brought into relationship with the United Nations shall automatically cease to be a member of the International Civil Aviation Organisation ;

(2) A State which has been expelled from membership in the United Nations shall automatically cease to be a member of the International Civil Aviation Organisation unless the General Assembly of the United Nations attaches to its act of expulsion a recommendation to the contrary.

(B) A State which ceases to be a member of the International Civil Aviation Organisation as a result of the provisions of paragraph (A) above may, after approval by the General Assembly of the United Nations, be re-admitted to the International Civil Aviation Organisation upon application and upon approval by a majority of the Council.

(C) Members of the Organisation which are suspended from the exercice of the rights and privileges of memberships of the United Nations shall, upon the request of the latter, be suspended from the rights and privileges of membership in this Organisation.

It is worth while examining the text of the amendment very closely, because we can then see just how carefully it is formulated to suit the special case. In reality, section B encourages Spain to apply for re-admission, should the causes of her expulsion later be eliminated.

The delegations which voted against the decision maintained that it was unfortunate that politics had to be mixed up in aviation. Outside the organisation, the ICAO Conferences were sharply criticised. The view of the airline companies was that they were not interested in political discussions, the costs of which had ultimately to be borne by civil aviation and thus by the airline passengers.

On the other hand, the gentlemen responsible for organising world aviation seem to be of the opinion that having Russia as a member would be worth the sacrifice. However, it remains to be seen whether the exclusion of Spain will really be followed by a Russian desire for membership. At all events the head of the American delegation, Under-Secretary of State Garrison Norton, declared at a conference that America would welcome Russia with open arms and not only would she declare herself in favour of the U. S. S. R.'s admission to ICAO, but would also support any eventual request by Russia for a seat on the Council.

What are the disadvantages now facing Spain since her expulsion ? First of all the Iberia airline concern will have to resign as a member of the International Air Transport Association. The IATA Article IV on membership, in Section 2, only admits members whose aircraft fly under the flag of a State eligible to membership in ICAO. Meanwhile, Article V on the termination of membership does not state that a company which is already a member of IATA has to drop out if the condition in Article IV disappears. Meanwhile, we may be fairly sure that IATA will not oppose ICAO in this respect. Thus Spanish civil aviation will lose the advantages hitherto offered it by IATA. In the drafting of timetables, the wishes of Spanish airline companies will not be heeded ; and they will not be able to use the clearing bank which IATA has formed for the benefit of its members.

It would be very wrong to assume, however, that these measures will incur a stoppage of Spanish airline operations. There has so far been no talk of cancelling any of the bilateral air agreements which individual States have concluded with Spain. Moreoever, it is fairly obvious that these individual States would not like to sacrifice the landing rights which they have already acquired in Spain.

Gando Airport, Las Palmas, Canary Islands, a trans-Atlantic stop. How will it be effected by the expulsion of Spain from ICAO ?

To Work !

In his inaugural speech, Dr. Warner said :

"Turning from the physical barriers to air navigation to those of legal and administrative character, substantial progress has been made in the facilitation of air commerce ; but one can hardly feel any real measure of satisfaction when so much remains to be done."

The matter lies in the hands of the gentlemen in Montreal. It is for them to benefit a war-torn world by giving effect to the obligation accepted in the Charter of the United Nation : "To promote social progress and higher standards of living in greater freedom."

Fear is a bad leader for those who wish to tread new paths. Hermetically sealing the frontiers can in no way rob a presumptive enemy of the means to obtain information. Long before the outbreak of World War II Japanese transport aircraft were forbidden to fly over Hawaii. Today we know very well that this did not stop the Japanese from taking air photographs of every military installation on the islands.

At the recent twenty-fifth anniversary banquet in Washington of the American Society of Newspaper Editors, David E. Lilienthal, the Chairman of the Atomic Energy Commission, was called upon to speak about research in this field. " In my office, there is a small, black cylinder of pure uranium weighing about two and one-half pounds, " said the orator. " Five years ago no man had ever seen even this small amount of pure uranium... The energy resulting from the three million billion atoms in this small cylinder, converted into electricity, would equal about the total daily use of electricity in the city of Washington, which now requires about 2,500 tons of coal. "

The flyer's horizon is wider than that of other humans. The horizon of all connected with aviation should be the same. Really airminded people should be the first to understand and bring into practice the cosmopolitan thoughts of the Greek Stoics.

Perhaps the day will come before long when all the airfaring nations, including Spain, will be able to sit around the ICAO conference table in perfect harmony. After all, the father of the rights of nations, Francisco de Vitoria, was a Spaniard. *He.*

Helicopter Pilot School

Jacques Guignard, former French fighter pilot, talking over the curriculum of the helicopter flying course with British-born Norman Edgar, Executive Vice-President of Helicopter Air Transport, Inc., at Camden Central Airport, N. J.

Chief Pilot Cashman, former A.A.F. helicopter instructor, and Guignard go over helicopter design drawings during ground school instruction.

Ground instruction : Cashman explains the workings of helicopter transmission systems.

A maintenance instructor explains the working of one of the two rotor heads of the Platt-LePage XR-1A helicopter.

A helicopter flying school was inaugurated at Central Airport, Camden, New Jersey, by Helicopter Air Transport, Inc., the largest private helicopter operating concern in the United States, last autumn. HAT, as the company is generally known, started its helicopter activities at the end of July, 1946, with a passenger charter flight from Bridgeport, Connecticut, to New York City. Since then it has carried out a wide range of charter missions and at present is negotiating contracts with various Governments for patrolling high-tension electric cables and pipelines and for hauling chicle out of the Central American jungles. President of HAT is Jonathan Wilford, Executive Vice-President is Norman Edgar, World War I captain in the British Army and organizer of some of the first commercial air services in Britain. Director of Operations and Chief Pilot is Frank T. Cashman.

When HAT inaugurated its training school last year, its equipment needs rose sharply. To cope with its increased commitments, it has meanwhile assembled a substantial fleet of helicopters : three Sikorsky S-51 four-seaters costing $ 55,000 each, six Bell 47B two-seaters valued at $ 25,000 each, some of which are yet to be delivered, and the four-year-old Platt-LePage XR-1A experimental twin-rotor helicopter originally built for the U. S. Army and now being rebuilt for crop-dusting and general utility. Other types will be added when they have obtained C. A. A. approval.

* * *

The training school, which is approved by the Civil Aeronautics Administration, the State of New Jersey and other Government bodies, has been an immediate success. The school includes a large lecture room for theoretical courses, together with a lounge and restaurant. Board and accommodation, however, are the responsibility of the students.

At the present time, HAT provides three flying training courses :

(1) *Sikorsky S-51 course* for pilots with a minimum of 500 solo hours in conventional aircraft and commercial rating : this course comprises 20 hours' dual instruction and solo flying, plus a ground course, and costs $ 2,000.

(2) *Bell 47-B course* for pilots with a minimum of 200 solo hours in conventional aircraft and with commercial or private rating : this consists of 25 hours' dual instruction and solo flying, plus ground course, and costs $ 1,500.

(3) *Transition course :* this represents a combination of the two other courses and comprises 20 hours of instruction in the Sikorsky S-51, 5 hours in the Bell 47-B and the ground course ; the fee is $ 2,300.

The *ground course* takes approximately 20 hours of lecture time and features the following subjects : history and development of rotary wing aircraft, theory of rotary wing flight, major assemblies, controls and transmission, practical work on and observation of helicopter maintenance.—While undergoing dual instruction or flying solo, students are insured to the amount of $ 50,000.

* * *

During the winter of 1947 a Frenchman, Jacques Guignard, arrived at Camden to take both the Bell and Sikorsky courses. Guignard was

an accomplished pilot on conventional aircraft when he joined the school : born in Paris in 1921, he enlisted in the French Air Force before the outbreak of war and trained as a fighter pilot. After the fall of France he escaped to England to join one of the international units of the Royal Air Force. Later he became a member of the "Ile de France Squadron" of the Free French Air Force and by the end of the war was credited with several victories in the air.

With the cessation of hostilities, Guignard became a test pilot for *Société Nationale de Constructions Aéronautiques du Sud-Ouest* (SNCASO), one of the French nationalized aircraft manufacturing concerns. Soon the company completed a unique but apparently practical rotary-wing aircraft design, called the SO 1100 "Giravion." When SNCASO decided to build the type, Guignard was selected to act as one of the test pilots and with another French student was sent to the U. S. A. to attend helicopter flight training schools.

* * *

At Camden, Jacques Guignard soon found out that piloting a helicopter was different from flying conventional aircraft. This change is so pronounced, according to rumour, that the U. S. Army Air Forces refuses to allow its helicopter pilots—who initially were trained on fixed-wing aircraft—to fly conventional military aircraft again after changing over to helicopters.

Three things Guignard discovered at once : first, whilst helicopters are directionally stable, they are not inherently stable about the lateral axis ; this means that, if you enter a dive and take your hands off the stick, the machine will not recover as an inherently stable aeroplane will do. Second, control "*feel*" of the conventional aircraft is absent in a helicopter ; as a result flying a helicopter is a purely mechanical process. And third, the controls of a helicopter are more numerous than in a fixed-wing type ; at present all helicopter manufacturers are endeavouring to reduce the number of levers to be manipulated.

The best-known helicopters are operated by the following controls :

(1) *Control column* ("stick") : This is situated in the position occupied by the stick in conventional aircraft and controls the cyclic pitch of the helicopter, i. e., the latter's horizontal movement within a full 360 degrees. The stick tilts the rotor by causing each main rotor blade to assume the highest angle of incidence at a given point in the rotational cycle and the lowest pitch at a point diametrically across the rotor disc. As a result, the helicopter can fly forwards, backwards, or sideways.

(2) *Foot pedals :* In the Sikorsky S-51 helicopter, the main rotor turns clockwise, from left to right as seen from the pilot's seat, and the resulting torque would cause the fuselage to turn to the left ; in the Bell 47B the rotor turns anti-clockwise and would therefore rotate the machine to the right. To counteract this, a vertical antitorque rotor is fitted on the port side of the tail of the Sikorsky, the starboard side of that of the Bell helicopter. But, by varying the angle of incidence of the vertical rotor blades, and hence the thrust they exert about the vertical axis of the aircraft, the antitorque rotor also provides complete directional control. The pitch of the vertical rotor blades is increased or decreased by depressing one or the other of the foot pedals—which in conventional aircraft fill a similar function by operating the rudder. But, since the main rotor torque will vary with the power output of the engine, the vertical rotor blade pitch has to be adjusted to varying flight conditions by means of the pedals.

(3) *Collective rotor pitch lever and throttle :* The main rotor pitch control lever is situated nearly horizontally to the left of the pilot's seat. When the lever is moved upwards, the pitch of both rotor blades is increased simultaneously, the lift augments and the helicopter rises. Pushing the lever down conversely

From the Sikorsky S-51 (vertical tail rotor is visible) students and instructor move over to the Bell 47-B.

Instruction in the field : Practical explanation of the Sikorsky S-51 rotor head.

An instructor describes the rotary system of the Bell helicopter, including the horizontal " stabilizer bar " (cf. elsewhere in this issue).

Flying training: The cockpit of the Sikorsky S-51. The rotor pitch lever with throttle grip on the left, foot pedals operating the vertical rotor, and stick for cyclic pitch control. S-51's used for training have dual controls.

Jacques Guignard inspects the Sikorsky S-51 cockpit.

Guignard, with left hand on throttle grip of Bell 47's collective pitch lever, listens to instructor reading off pilot check list.

decreases pitch and lift. The hand grip of the lever incorporates the throttle : when twisted to the left, engine output is increased, whilst turning it to the right decreases power. Hence, for climbing the lever should simultaneously be pulled up and its grip twisted to the left. However, by a system of cams, pitch and throttle controls have been made to be synchronous once the throttle is adjusted to provide the desired rotor speed.

* * *

Guignard's discoveries did not end there, however. He found for example, that helicopters do not react to movements of the controls as quickly as conventional aircraft. When he moved the stick to the right for the first time, nothing happened at first, but after a brief second the helicopter obeyed. When he pushed the stick forward, the machine seemed to lose altitude for a moment before it decided to fly straight ahead ; this was due to the fact the inclination of the rotor resulting from the control movement produced a temporary decrease in lift, which ceased as soon as the machine gained forward speed. The first reaction of a helicopter student pilot to this slowness of the controls is usually a tendency to over-control, but this is soon remedied as he gains experience and becomes familiar with the habits of his machine.

Another sensation the novice in helicopter flying experiences, despite the fact that he knows this to be one of the primary features of the helicopter, is that he feels as safe as a house. He feels that in case he got lost in dirty weather he could practically "walk home" by following familiar roads or railway lines at low altitudes, or that he could sit down in any cabbage patch and wait for the sun to come through.

He knows, furthermore, that even in the unlikely event of his engine conking out he could still make a safe forced landing without, as often happens with fixed-wing aircraft, over-shooting the cow pasture he has chosen for an emergency descent and wrecking his aeroplane between the two tree trunks at the far end.

Should the engine fail, the rotor would by no means stop and the aircraft plummet to earth. The pilot would effect an autorotation landing, made possible by the fact that the rotor would continue to "windmill" in the air stream, providing enough lift to ensure a fairly slow descent. In the Bell 47-B this descent amounts to about 19 ft. per second which, coupled with the forward speed of the aircraft, permits

Take-off.

A Sikorsky S-51's blades are " tracked " by applying chalk of different colours to the tips of the rotor blades, which register on a canvas strip held aloft on a steel pole. If differentiations of more than one inch are recorded, blades require re-adjustment.

One of HAT's Sikorsky S-51's piloted by a student on a training flight.

landings in relatively small areas. Just before touching down, the pilot would pull the collective pitch lever upwards, so as to increase lift and check the rate of descent at the last moment before contacting the ground.

* * *

In order to graduate from the helicopter pilot school, a student must master the technique of finely synchronising the movements of the various controls of his aircraft. Helicopter flying schools have found that the best method of teaching a pupil to co-ordinate the manipulation of rudders, stick and pitch lever is not to force him to operate more than one of the controls from the beginning, but rather to give him time to familiarize himself with each individual control.

Jacques Guignard has meanwhile returned to France and is now testing the "Giravion," which quite recently started its taxi trials and initial test hops. *P. A. B.*

SO 1100 " Giravion " of the S.N.C.A. du Sud-Ouest.

Taxi Please!

By Gideon

One of these fine days you will be able to drive out to the airport and call : "Taxi please ! Paris, Saint-Honoré 10 !" and you will fly off with the first pilot to have his jets going.

However, we are not yet that far ahead.

"Excuse me, Sir," replies one of the representatives of the three-hundred and eleven Central European air taxi companies (three-hundred and eleven at the moment of going to press, nine o'clock in the morning), "Excuse me, Sir, you only need to 'phone, and your taxi will be ready. Destination—anywhere on earth." And old Mr. H. M. Appley, of Appley Air Services, a veteran pilot of World War I, shakes his head in disapproval of your ignorance. After all, his air taxi service is the traveller's ideal.

"It's your business, Mr. Appley, and I have no wish to spoil it for you ; but please don't count on me as a passenger. Do you imagine for one moment that I would entrust my life to your old single-engined crates ? What do you do when the weather is bad, or when night falls ? No, Sir !"

"Quite correct," interrupts Mr. Pulham, of 'Pulham's Everywhere.' "Use my twin-engined aircraft, Sir. I'll show you what service to customers means."

"Pulham's Everywhere—don't make me laugh. And as for your twin-engined transports, I know very well that they are antiquated 'Sparrows.' Look here, I once flew with you from London to Marseilles. Just before Abbeville, you had to fly through a cloud bank and your carburettor froze. Thank goodness, the airfield was clear of fog. When we left, I had to leave my big suitcase behind . . . to reduce the take-off weight ; a good, pig-skin suitcase, too, from Horne's, in Dale Street, Liverpool ; and I haven't had it back yet. Did I by chance say I flew to Marseilles ? My mistake ; I took the train."

* * *

At a nearby table, Captain Andrews, Chief Manager, drains his glass of whisky in one gulp and mumbles disdainfully : "Sparrows ! Who ever flies around in such old kites nowadays ? Ought to charter from 'Mulligan's Green Planes.' Good, solid aircraft ; bright green, high-speed, low-wing monoplanes with retractable undercarriage ; drinks served on board ; London to Stockholm non-stop."

"How do you do, Captain ?" you say. "Pass me that bottle so that I can forget all about 'Mulligan's Green Planes.' Where the devil did you ever get your pilots from, Captain ? Right from flying school ? Only recently one of them tried to land in Zurich. Granted that the ceiling was low ; about 600 feet. But he never even got to anywhere near the runway. At the third attempt, the passengers as well as Mulligan's planes were green—with fright. Yes, Sir !"

And now you refuse to allow Messrs. Apply, Pulham and Andrews to interrupt you any further. You go right ahead and tell them about the unfortunate passengers stranded on European airfields, waiting for the airtaxi which they have ordered and which fails to arrive ; because the weather is bad ; because it had to make an emergency landing somewhere ; because the engine has failed ; because the undercarriage is frozen ; because the pilot could not find the airfield ; because the ceiling is too high ; because the ceiling is too low ; because it is snowing ; because night has fallen.

You tell them all about the mythical comfort provided for passengers. Getting out of most of the air-taxis is something between climbing down a cliff and crawling through a barbed wire entanglement. If a passenger has had the good fortune to surmount the various handbags, auxiliary equipment, radio paraphernalia, and got to the door without mishap, he still has to contend with the *pièce de résistance,* the wobbly stepladder which is finally to lead him to earth. If the passenger is a young lady, a certain amount of charm in this gymnastic feat is conceivable ; but if the passenger happens to be an elderly lady, well, there is nothing else for it but two hefty mechanics.

You continue your dirge with a description of how passengers are stranded in foreign countries with no negotiable assets besides their return tickets. You watch tears coming to your listeners' foxy eyes as you tell them of how people sometimes have to condescend to borrow twenty francs from the airport messenger-boy in order to pay for a night's rest.

* * *

Then, after your little chat with Messrs. Appley, Pulham and Andrews, you wend your way back home. At night you start dreaming . . . of air-taxi companies whose aircraft are better equipped than those of major airline concerns, just because they are apt to meet with more varied and often more complicated obstacles ; which not only have a small radio receiver on board, but a radio compass, beacon receiver, short-wave equipment, VHF-telephony, and every other gadget for safe flying. You dream of pilots who, having flown millions of miles on air routes all over the world, have gathered enough experience to offer an all-weather, all-route, day-and-night air-taxi service. And wonderful pictures flash through your brain : eager agents, whose sole worry is for your comfort ; a ground organisation, which sees that you are carried from your doorstep to the airport ; wide, shining gangway steps ; inviting, airy, heated aircraft ; punctuality ; security ; comfort . . .

And you let out a sigh :

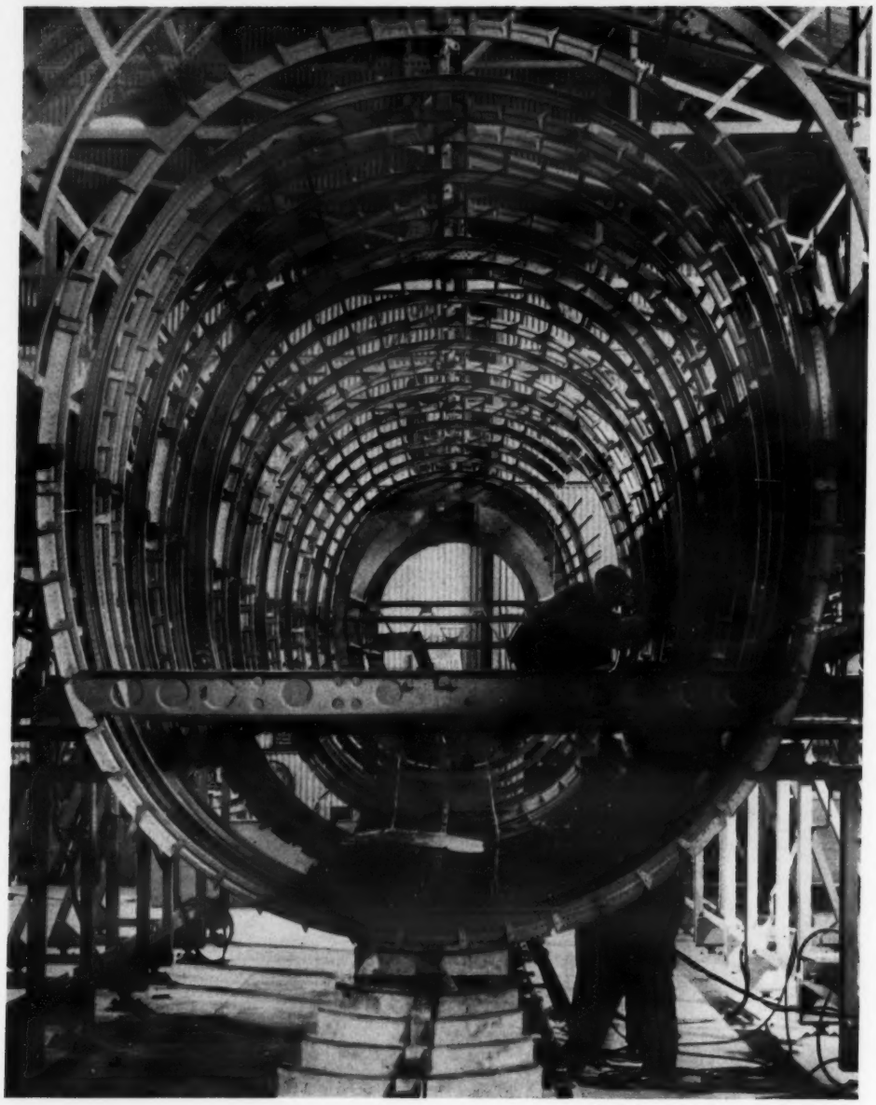
"Air taxi, yes ; but some other day, thank you !"

Vickers "Viking I B"

From a brief review of the airlines' equipment in twin-engined transports for short and medium routes, it becomes evident that the obsolescent Douglas DC-3 still comes first from the quantitative point of view. Although quite a number of leading aircraft firms in various countries are developing more modern planes to replace this " work horse of the air," it will probably be some time before they are ready for actual service. In anticipation of a postwar demand for new aircraft of this category, the aircraft section of *Vickers-Armstrongs, Ltd.*, already began designing the *Vickers V.C. 1. "Viking"* twin-engined commercial transport during the last months of the war. The manufacturers had in mind to build a transitional type which, though embodying as many as possible of the newest features, would not require too long a time to develop and test, and which could be produced without an excessive amount of jig and tool conversion.

It is therefore not astonishing to discover many of the basic features of the well-known Vickers " Wellington " twin-engined bomber re-appearing in the "Viking," and that the two aircraft are approximately identical in size. For instance, the first version to be built, the " Viking I A " or " short-nose Viking," has exactly the same fabric-covered wing and tail control surfaces as the " Viking," so that the bomber's parts could be transferred directly to its peacetime counterpart. In this way, one of three prototypes could be completed shortly after V. E. Day, and be subjected to its first test flight on June 22nd, 1945. Thus the " Vikings " became the first British postwar commercial transports to be acquired by British Overseas Airways Corp. ; they have since been taken over by BOAC's sister corporation, British European Airways Corp. The fact that the " Viking " has been able to acquire a name in its relatively short period of existence is because it has also been bought by a good number of airline companies outside Great Britain. Moreover, readers will recall that the King's Flight, the R.A.F. transport unit reserved for the use of His Majesty King George VI, is composed of four " Vikings."

The following paragraphs refer to the new version at present in quantity production, the " Viking I B " or " long-nose Viking." As may be deduced from its name, it differs externally from the original design in that it has a longer nose portion (28 inches longer). There are, however, certain constructional differences too, as will be seen later on. The new model has benefited by the fact that the manufacturers, no longer shackled by war contracts, have been able to devote more attention to converting the workshops.



The fuselage framework of the " Viking ": note the elliptical frames and longitudinal stringers, and the beams for supporting the cabin floor. On the main frame can be seen the rubber-padded bushes for the wing attachment. Aft can be seen the sturdy tail-portion frames and the extended spar of the tailplane.

General

It can be seen from the accompanying photos that the " Viking " is a twin-engined all-metal mid-wing monoplane of orthodox construction, fitted with a retractable conventional undercarriage. At a recommended gross weight of 34,000 lbs., the " Viking I B " is usually equipped to accommodate twenty-four passengers. If desired, however, it can also be fitted for 27, as the extension of the fuselage affords room for an additional row of seats.

Besides endeavouring to afford the passengers every possible comfort, the manufacturers have also concentrated on simplicity of maintenance and servicing. The low purchase price of the aircraft and its moderate operational costs will appeal to the profit-conscious airline operator. The crew needs to comprise two pilots, a radio operator, and a steward or hostess.

Construction

The wing is of trapezoidal shape and possesses a span of 89 ft. 3 in. The trailing edge is fitted with hydraulically-actuated split-type flaps between the fuselage and ailerons. Whereas the geodetic structure of the " Wellington " has been transferred entirely to the wing of the " Viking I A," it has only been incorporated in the wing centre section of the " Viking I B." The outer wings, extending from the engine nacelles, are of conventional stressed-skin design in the newer model.

The bending strain due to the lift forces is supported by a continuous main spar. In the outer panels, this spar consists of a pair of light-alloy T-section booms, machined from solid bar and tapering towards the tips, with a shear plate-web; the centre section, of geodetic structure, is built up around a main spar consisting of tubular booms connected by diagonal bracings. In reality, the assembly forms a double spar, whereby a pair of identical spars are joined to form a single unit. The spars of the three wing sections are joined together with multiple lugs and pins. The construction of the outer wings merits attention, as the constructional members which give the form of the aerofoil section, are more to be regarded as chordwise skin stiffenings than ribs. They consist of lipped channel sections and extend from the main spar to either the front or rear auxiliary spar. These chordwise members feature no bracing, except in the vicinity of the aileron hinges, so that the wing interior offers unobstructed space for housing fuel tanks. The front auxiliary spar of the outer panels may be regarded as a box spar corresponding to the aerofoil section of the leading edge. It consists of two lipped channels, an arc-section web forming the inner wall of the box, and the skin proper forming the outer wall. Rubber-pressed, lightened diaphragms preserve the form of this spar. A hollow-backed, flanged channel, forming the actual leading edge, is mounted on the diaphragms and, besides providing an additional spanwise reinforcement, also serves to hold the porous metal elements which distribute the de-icing fluid. The rear auxiliary spar consists of a semi-octagonal channel section. The upper skin, extending beyond this spar because of the split flaps, is supported by small outriggers.

The geodetic wing centre section is divided into two parts, as the main spar features a division in the plane of symmetry of the aircraft. A multiple lug connection is again used in order to provide an undisturbed force transmission from one half to the other. In contrast to the outer wings, the geodetic panels, and not the skin covering, are used to support the torque and shear loads.—Readers are reminded in this connection that in geodetic constructions the structural members are located as near as possible to the surface and form a lattice running in the direction of the main stresses, in the present case at about 45° to the wing span direction, so that a very sturdy construction is produced, which already embodies the desired external form and usually requires no further reinforcement.—The geodetic lattice of each centre section half, in addition to the main spar, is anchored to the front and rear auxiliary spars, and to the two end ribs. Each auxiliary spar is composed of two C-section booms with a riveted reinforced plate web. The interior end rib is of braced tube construction, whereas the outer end

rib is of simple tube construction. As already mentioned, only the main spar is continuous, and the auxiliary spars do not extend further than the engine nacelles. The rear auxiliary spars of the outer and centre sections terminate in a forging which forms the rear fairing of the engine nacelles, whereas a short, girder-braced spar, integral with the nacelle structure, connects with the front spars. Two box-type vertical bracings between the main spar booms contain the trunnions for the engine mountings. The end ribs of the outer wings and centre section are curved to fit the contour of the nacelles. Twelve externally-accessible, quick-release screws for each of these ribs, picking up corresponding points on the nacelle, form additional means of attachment.

The skin of the outer panels consists of 27-inch wide light alloy panels of 20 and 21 s.w.g., fastened to the spar flanges and ribs by sunk rivets. The panels are butt-jointed on internally-fitted, riveted straps. The skin of the centre section is not stressed and is not attached directly to the geodesics, but is riveted to top-hat section members which run chordwise and are screwed to the geodesics.

Wing centre section with power plant installation, attached to the fuselage. The photo shows the wing-fuselage joint. On the fuselage end of the front auxiliary spar can be seen the fitting on which the two links are attached; the links are then fastened to the fuselage with the help of rubber-padded lugs. The rear auxiliary spar connection is similarly designed.

Fuselage

The fuselage is of almost constant elliptical cross-section and incorporates an orthodox semi-monocoque construction. The framework consists of frames built up of 20 s.w.g. light-alloy lipped and fluted channel sections, and stringers of beaded angle section, which, instead of being notched to the frames, are connected by means of angle plates. Thus the only skin rivets are with the stringers, except in the immediate vicinity of doors and windows, or at other highly stressed regions. Here too, however, the skin does not come to lie directly on the flanges of the frames, but on local boundary members which are riveted to the frames. The circumferential panel joints do not overlap and are bridged by channel section butt straps on the interior. In contrast, the longitudinal joints overlap, whereby each lap-joint coincides with a stringer and is fastened to it by means of mushroom-head rivets. The remaining attachment of the 22 s.w.g. and 20 s.w.g. covering to the framework is in every case by means of flush riveting.

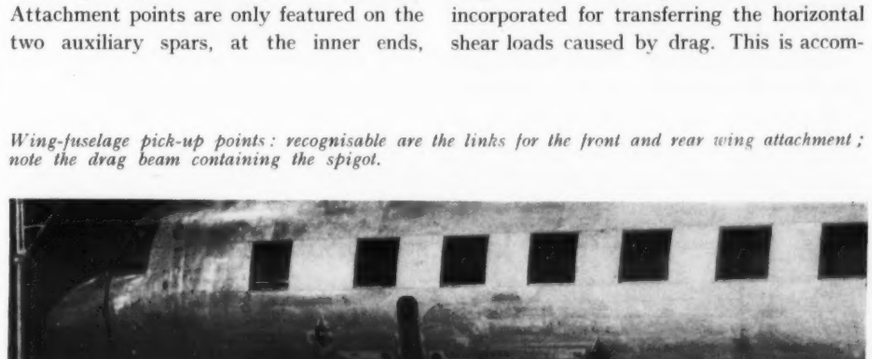
The floor of the main cabin is supported on a row of channel section beams of 16 s.w.g. light-alloy sheet, each beam being fastened with only eight rivets at either end to the back of the frame section; their attachment is illustrated in Fig. 1. This simple floor construction leaves a useful amount of luggage space in the fuselage belly. The floor of the luggage compartment is of corrugated sheet and secured to bearers mounted on the frames. Attachment to the fuselage stringers is by means of shear plates at the outboard edges. This floor arrangement also contributes towards the strength of the fuselage.

The rear fuselage portion, including the pick-up points for the tail assembly, forms a separate unit which comprises three rather sturdy frames and also incorporates the extended part of the elevator unit spar.

In the fin and tailplane, the original geodetic structure with fabric covering has likewise been replaced with a stressed skin and girder-braced spar construction.

In conclusion to the description of the construction, special emphasis may be placed on the joining of the wing to the fuselage. Attachment points are only featured on the two auxiliary spars, at the inner ends, whereas the main spar runs through the fuselage without any attachment and is free to float vertically. The auxiliary spars are articulated at the attachment points by means of two links per joint to the corresponding reinforced fuselage frame. On the side of the fuselage these links pivot on pins which are retained in rubber padded bushes, so that a certain amount of flexibility is given to the entire wing attachment. This arrangement enabled the designers of the "Viking" to eliminate wing vibrations due to the engines and drag wind. As the links are only capable of transmitting vertical and longitudinal forces, a special device has been incorporated for transferring the horizontal shear loads caused by drag. This is accom-

Wing-fuselage pick-up points: recognisable are the links for the front and rear wing attachment; note the drag beam containing the spigot.



Main landing wheel of the "Viking."

plished with the help of a spigot mounted at the rear end of a drag beam on each side of the fuselage (Fig. 3). It engages with a sliding block attached to the inner end rib of the wing, and transmits the drag loads as shear stresses to the fuselage skin.

The main landing wheels, which retract upwards into the engine nacelles, are equipped with pneumatic brakes. A means of working the brakes differentially with the rudder bar simplifies taxiing. For reasons of aerodynamic refinement, the tail wheel is also retractable. The hydraulic and pneumatic systems are actuated by two engine-driven pumps. In this connection, it may be mentioned that the two generators for supplying electric power for starting, lighting, etc., are also driven by the engines.

Power Plant

The necessary power is supplied by two Bristol "Hercules 634" air-cooled fourteen-cylinder twin-row radials, each developing a take-off output of 1,690 H.P. and driving a four-blade hydraulic c.p. airscrew of 13 ft. 3 in. in diameter. In a case of engine cut-out, the blades of the airscrew in question can be feathered in order to reduce the drag. In order to maintain the recommended economic cruising speed of 210 m.p.h., the "Viking" only requires an output of 775 H.P. per engine, i.e., merely 50 per cent of the maximum continuous power. This assures long engine life and a considerable number of hours between each major overhaul. The engines are designed on the "power egg" principle, so that they also contribute towards lowering the maintenance costs in that they can easily be dismantled and interchanged. In addition, the work of the ground staff is considerably simplified by the provision of easy access to the refuelling points, external connections, etc., and by the incorporation of numerous well-conceived access and inspection panels throughout.

A fuel supply of 750 Imp. gals. is carried in several tanks housed in the outer wings and engine nacelles. This supply gives the "Viking" a maximum range in still air of 1,700 miles. Fully-automatic Hobson R.A.E. fuel injectors, which permit a closer adjustment of mixture strength, also contribute towards the economy factor of the aircraft in that they keep the fuel consumption down to a minimum; for economical cruising, 0.410 to 0.415 lb./H.P./hr.

Furnishing and Equipment

Fig. 5 shows the division and seating arrangement of the standard version for 24 passengers. In view of the fact that the main spar of the wing has to cross the cabin floor, it was found best to divide the passenger cabin at this point. The forward compartment contains nine seats and the rear compartment, either fifteen or eighteen seats. The upholstered armchairs have fixed angle backs with adjustable winged headrests incorporating individual reading lamps. Moreover, a table is provided for the convenience of each passenger. Good visibility conditions invariably appeal to passengers, and the "Viking" undoubtedly scores in this direction, with its large square windows. All the windows in the saloon are designed as "pull-in" escape apertures for use in emergency. The galley is located in the rear portion, directly aft of the main cabin and opposite the entrance door. Aft of this is the lavatory and wash-room with constant hot water. To the right of the entrance door are hooks for hats and coats. The nose portion contains the crew's compartment, which has a door leading into the passenger cabin. The seats for the pilot and co-pilot are arranged conventionally side by side, and the radio operator is seated to starboard behind the pilot, with his equipment set up against the starboard wall. The two pilots have all the usual flight and engine controls at their disposal, including, of course, an automatic pilot.

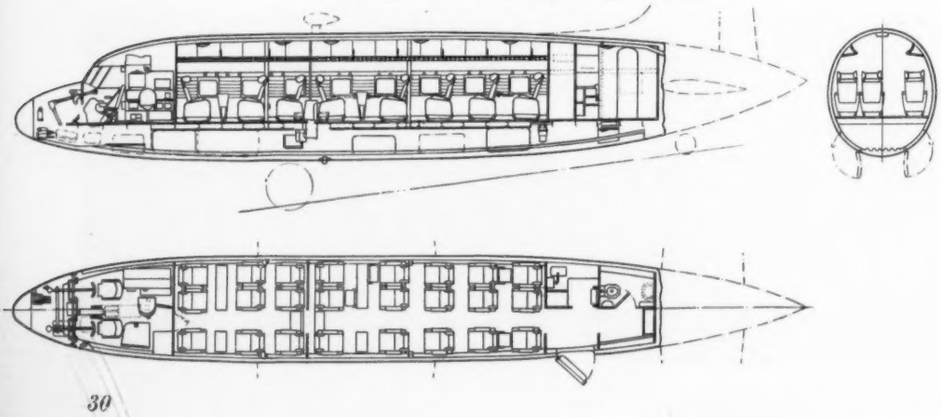
An air-conditioning system continually supplies the compartments with fresh air, controlling it for both temperature and ventilation. A heat exchanger, working with the exhaust gases, supplies the necessary warm air. Both cold and exhaust-heated fresh air are fed into a mixing chamber, from which the fuselage supply is ducted for diffusion from multiple inlets through the floor. The vitiated air is aerodynamically extracted through a central ceiling duct. In addition, each passenger has control of a separate cold air supply. Finally, passengers are not bothered by noise as the cabin walls are thoroughly soundproofed.

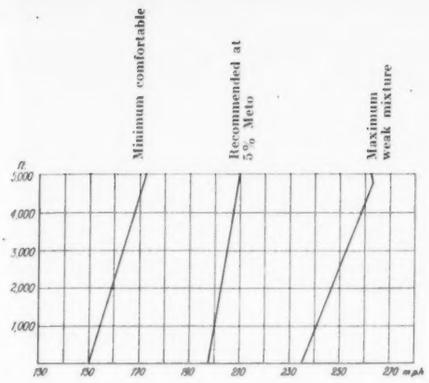
As already mentioned, the space beneath the cabin floor (270 cu. ft.) is used for stowing luggage, freight and mail. It is easily accessible from the ground and five sufficiently large doors enable loading and unloading to be carried out rapidly. If desired, this space can be divided into five separate holds. The already described sturdy construction of the cargo floor permits high density loads to be accepted, a feature which will obviously be found advantageous when operating in the less developed regions of the world.

Performance

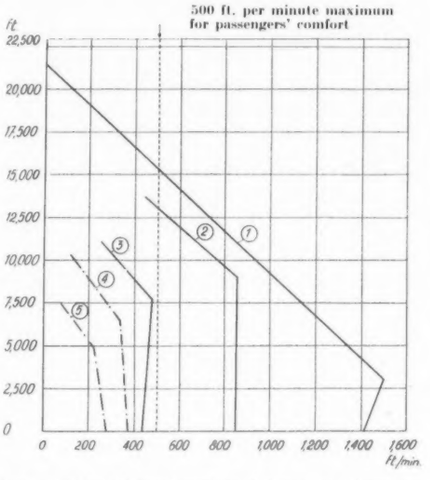
Normal cruising is based on a speed of 210 m.p.h. at 10,000 ft., under which conditions only 50 per cent of the maximum continuous output is used. However, correspondingly higher cruising speeds may be achieved at greater outputs, for instance 262 m.p.h. at maximum weak mixture, whereas 171 m.p.h. is the minimum comfortable speed (both at 10,000 ft.). At the recommended cruising speed of 210 m.p.h. an operational range of 1,040 miles is obtained with maximum tankage, or 575 miles with 2/3 tankage. This is with allowance to cover: warm-up, take-off, 200-mile flight against 40-m.p.h. wind to an alternative landing field, stand-off at minimum power, circuit

Fuselage division of 24-passenger version.

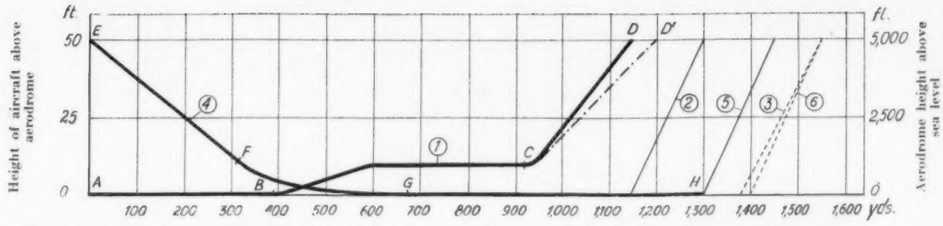




Cruising speed plotted against altitude for different outputs and an average gross weight of 31,800 lbs. The curve on the left indicates the minimum recommended speed, below which perturbed flying characteristics occur so that it should not be fallen short of for the passengers' sake.

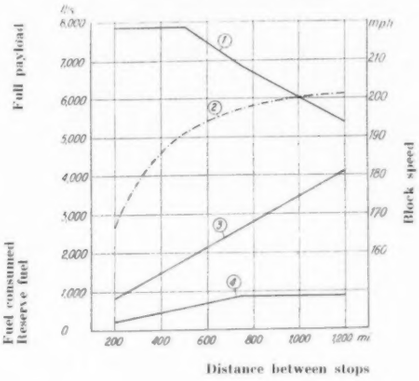


Rate of climb plotted against altitude at different outputs and a gross weight of 34,000 lbs.
Curve 1: climbing at max. climb output
Curve 2: climbing at max. weak mixture
Curve 3: climbing on 900 H.P. per engine
Curve 4: climbing on one engine at full power
Curve 5: climbing on one engine at full climbing power.



Take-off and landing performance of the "Viking".

Curve 1: Separate take-off phases at sea level in ICAN conditions with no wind (at 34,000 lbs. gross weight).
A-B: Ground run
B: Leave ground at 95 m.p.h.
B-C: Accelerate to 115 m.p.h. safety speed while raising landing gear
C-D: Climb to 50 ft. at 115 m.p.h.
C-D': Climb to 50 ft. at 115 m.p.h., assuming one engine fails at C.
Curve 2: Entire take-off distance over 50-ft. screen plotted against airfield altitude, in ICAN conditions.
Curve 3: Same as curve 2, but in tropical weather.
Curve 4: Separate landing phases at sea level, in ICAN conditions and no wind (32,500 lbs. gross weight):
E-F: Glide in at 105 m.p.h. down 2½° flight path on beam approach.
F-G: Float off to lose speed.
G: Alight at 90 m.p.h.
G-H: Ground run.
Curve 5: Landing distance over 50-ft. screen plotted against airfield altitude, in ICAN conditions.
Curve 6: Same as curve 5, but in tropical weather.

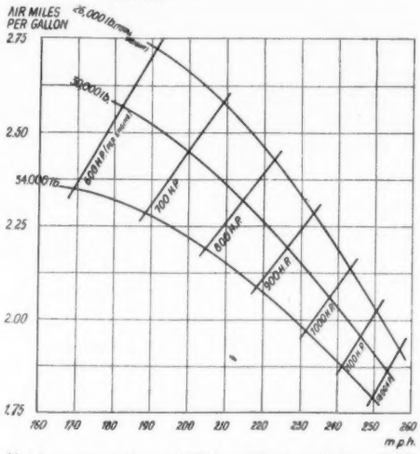


An example of commercial operation:

Curve 1: Payload (in lbs.)
Curve 2: Average point-to-point speed (in m.p.h.)
Curve 3: Total fuel consumption (in lbs.)
Curve 4: Remaining fuel reserve (in lbs.)

Plotted against route distance

The details refer to 210 m.p.h. cruise at 10,000 ft. in still air, carrying reserve fuel and oil for 1/3 of block distances up to 750 miles, or for 250 miles on longer distances.



Fuel consumption plotted against cruising speed for different gross weights and outputs, for cruise at 10,000 ft.

and approach, landing and taxi-in; the operational range on the remaining fuel is then calculated on the assumption of a 40-m.p.h. headwind throughout. The climbing performance of the "Viking" also merits attention. Should it be thought advisable, in view of the passengers' comfort, to limit the rate of climb to 500 ft./min., the initial rate of climb of 1,450 ft./min., which increases to 1,500 ft./min. at 3,000 ft., can be regarded as a considerable reserve. This allows the aircraft to climb on considerably reduced output and simultaneously provides a good safeguard against engine trouble. In point of fact, a mean rate of climb of 400 ft./min. can be achieved on 900 H.P. per engine. In a case of cut-out of one engine, there is still sufficient power to afford the fully-loaded aircraft an initial rate of climb of 347 ft./min. at full output, or 276 ft./min. at max. climbing power. The take-off qualities are likewise extremely favourable: under normal ICAN conditions, the "Viking" is 50 ft. off the ground after 1,150 yds., and only requires a further 50 yds. in order to attain the same result if one engine fails during the take-off run. Should an engine fail during the moment of becoming airborne, the aircraft can be brought to a standstill at a distance of 1,300 yds. measured from the start.

F. P.

Demonstration of "Viking I B" at Cointrin Airport, Geneva.

A BEAC "Viking" takes off.

Dimensions:

Span	89 ft. 3 in.
Overall length	65 ft. 2 in.
Overall height on ground	19 ft. 6 in.
in flight attitude	24 ft. 0 in.
Wheel track	22 ft. 10 in.
Wheel base	33 ft. 5 in.
Tyre size	45 in. × 16 in.
Wing area, gross	882 sq. ft.
Standard mean chord	9.88 ft.
Aspect ratio	9.0

Compartments:	Length	Average width	Average height	Volume
Forward saloon	11′ 1″	7′ 11″	6′ 7″	520 cu.ft.
After saloon	19′ 6″	7′ 11″	6′ 7″	915 cu.ft.
Vestibule and cloaks	9′ 0″	3′ 6″	6′ 3″	170 cu.ft.
Galley	4′ 3″	3′ 8″	6′ 3″	90 cu.ft.
Toilet	4′ 6″	3′ 3″	6′ 0″	80 cu.ft.
Crew's quarters	11′ 8″	6′ 5″	6′ 0″	305 cu.ft.
Luggage and freight hold	31′ 4″	—	1′ 10″	270 cu.ft.

Note: All the above dimensions are internal and with the exception of the hold the areas and volumes quoted are gross values, including space occupied by seats, cupboards, etc. The hold volume quoted is the effective capacity allowing for losses at door openings.

Power plant:

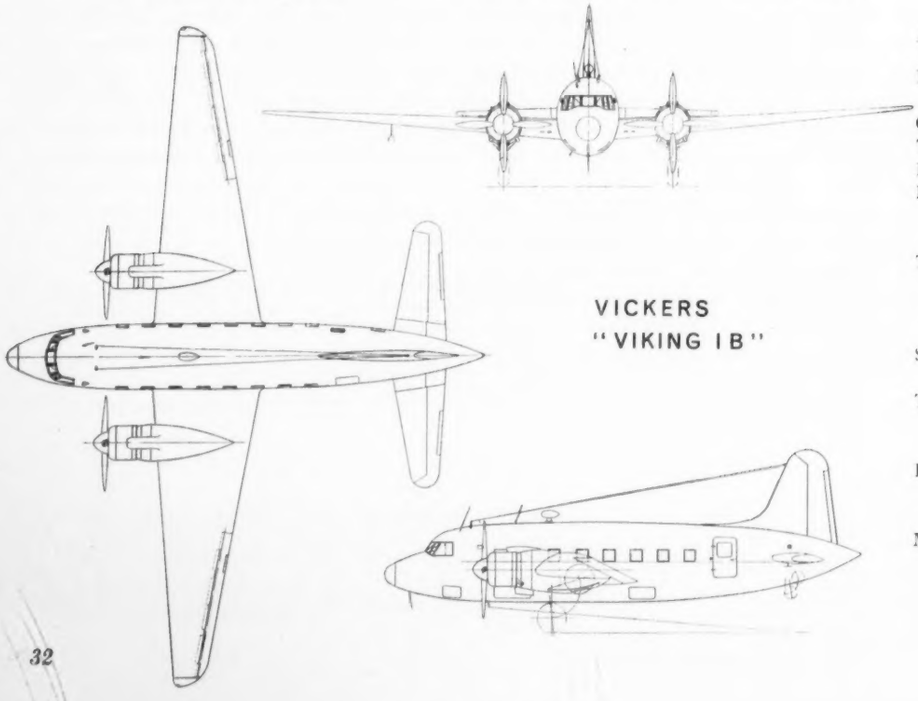
	Power	r.p.m.	Boost	Altitude
2 Bristol "Hercules" 634:				
Take-off power	1,690 H.P.	2,800	+ 7½	sea level
Rated or max. continuous power	1,550 H.P.	2,400	+ 6¼	4,750 ft.
Max. weak-mixture cruise	1,330 H.P.	2,400	+ 3¼	9,250 ft.
Recommended cruise	775 H.P.	1,750	0	10,000 ft.

Weights:

Structure	10,405 lbs.	
Power plant	6,965 lbs.	
Fuel and oil system	875 lbs.	
Power services	545 lbs.	
Fixed equipment	2,830 lbs.	
	24 seats	*27 seats*
Removable equipment	1,290 lbs.	1,380 lbs.
Empty weight with all equipment	22,910 lbs.	23,000 lbs.
Disposable load	11,090 lbs.	11,000 lbs.
Max. take-off weight	34,000 lbs.	
Max. landing weight	32,500 lbs.	
Surface loading at take-off weight	38.5 lb./sq. ft.	
Surface loading at landing weight	36.8 lb./sq. ft.	
Power loading	10.05 lb./H.P.	

Examples of weight distribution for 24-seater version:

Distance	200 miles	600 miles	1,200 miles
24 passengers	4,080 lb.	4,080 lb.	4,080 lb.
Luggage	1,320 lb.	1,320 lb.	895 lb.
Freight	2,060 lb.	1,700 lb.	0 lb.
Food, drink and service	400 lb.	400 lb.	400 lb.
Payload	7,860 lb.	7,500 lb.	5,375 lb.
luggage	780 lb.	780 lb.	780 lb.
Reserve fuel and oil	1,060 lb.	2,810 lb.	4,935 lb.
Disposable load	9,700 lb	11,090 lb.	11,090 lb.
Standard tare weight	22,910 lb.	22,910 lb.	22,910 lb.
Take-off weight	32,610 lb.	34,000 lb.	34,000 lb.



Performance:

Recommended cruising speed	210 m.p.h. at 10,000 ft.
Cruising consumption	91 Imp. gal./hr.
Take-off speed	95 m.p.h.
Landing speed	90 m.p.h.
Max. still-air range	
with 500 Imp. gals.	1,130 miles
with 750 Imp. gals.	1,700 miles
Take-off distance over 50-ft. screen (at sufficient flying speed to ensure control should one engine fail on the climb)	1,150 yds.
Shortest take-off distance over 50-ft. screen	850 yds.
Take-off distance over 50-ft. screen with one engine failing after safe flying speed	1,200 yds.
Landing distance over 50-ft. screen, assuming 2½° glide-in for beam approach	1,300 yds.
Minimum landing distance from 50 ft.	850 yds.

The Development of the V2

By S. F. Erdmann, B.Sc., Amsterdam

(Concluded. [1])

Jet Tab and Flettner Flap Control

The free flight tests had revealed how important it was that the twist be carefully compensated during the piercing of the sonic barrier. In a way this was a revelation, but bench experiments executed some years earlier had all the same disclosed that, besides endangering the projectile's passage to supersonic speed, rotation about the longitudinal axis also constituted a hazard to the entire control. It was planned to incorporate a plane stabilised by gyroscopes in the controls. Meanwhile, it is known that a gyroscope opposes itself to any alteration in orientation, or else tends to resist such alterations with a displacement perpendicular to the direction of the movement. The latter case occurs when the projectile turns about its longitudinal axis to such an extent that the gyroscope reaches its limit. The plane then changes its position. A movement exceeding a certain amplitude causes the gyroscope to overbalance. This spells havoc for the control, and a catastrophe ensues. It was found that the maximum permissible angle of rotation φ about the longitudinal axis should not exceed 55 degrees.

The control of the projectile involved the following principles. In order that it should keep strictly to the prescribed trajectory, a very exact control in both elevation and azimuth was indispensable. To make this at all possible, the twist had to be compensated efficaciously. The precision of the control depends to a certain extent on the wind conditions, but primarily on the mechanics of flight. This can be calculated in advance, and precise azimuth and elevation control can be assured by bringing the requirements of the mechanics of flight in accordance with the possibilities of the controls. The question of the twist is more delicate. This is caused by side winds and chance external dissymmetry. As the latter can vary considerably in different projectiles, it cannot be calculated in advance and may, therefore, exercise a considerable influence.

It is above all in the empennage where any eventual dissymmetry in the construction will influence the twist. Hence, experiments were carried out to investigate the rolling moment for different settings of the empennage, starting at a Mach Number of only 0.14. Experience available at that time led one to expect the highest coefficients of moment in this speed zone. It was thought that measurements were not necessary for higher speeds, and that the control could be dimensioned from this first series of tests. In free flight trials, however, the control was found inadequate. Supplementary tests executed in the compressible region and at supersonic speeds, without regard for the very great experimental difficulties, gave the results which are expressed in Fig. 9. It can be

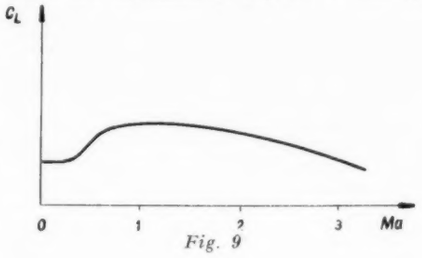


Fig. 9

seen that the majority of the coefficients are twice as high as those resulting from the initial series of measurements. This effect could not be explained. It is possible that an error occurred in the measurements or calculations for the initial experiments, but this can no longer be ascertained. It could not be proved whether the angle of incidence had any influence. Thus, for a given projectile, moments were to be expected which were proportional and in the same sense as the dynamic pressure, but independent of any other flight conditions.

The influence of side winds on the rolling moment was subjected to tests: for large angles of incidence between the projectile and the wind, a stable position of rest ($c_L=0$) resulted at an angle $\varphi=45°$, and an unstable position at $\varphi=0°$ (Fig. 10).

Angles of 20° produce a reverse point. At smaller angles, the stability conditions are inverted. For a constant side wind, therefore, the rolling moment curve inverts itself when the speed increases; and alternating strains are placed on the automatic control.

If constructional dissymmetry were to be compensated by the jet tabs, the latter would continuously be loaded on one side, and increasingly so with the dynamic pressure; it would create extraordinary complications for the tabs' other functions. This is where the Flettner flaps come to the rescue. They can compensate the rolling moment with a corresponding deviation. Once this deviation has been properly set, there is scarcely any need for correction. In contrast, the flaps are not suitable for compensating the influence of side winds, this influence being at a maximum for an angle of incidence of 90°, thus during the

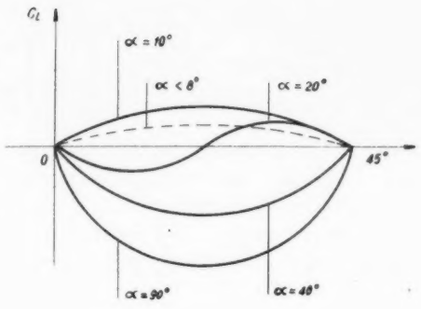
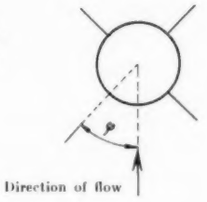


Fig. 10
Side-wind influence on rolling moment.



take-off; and as the projectile then has no relative wind, they are consequently inefficacious. On the other hand the side wind influence can quite easily be corrected by the jet tabs, for this influence diminishes with the angle of incidence, thus as the speed increases. In the end, this influence becomes altogether insignificant. Hence, instead of the initially conceived control solely by jet tabs, a combined jet tab-Flettner flap control system was adopted. Originally meant as pure trimming tabs, the Flettner flaps were primarily to compensate the time-constant rolling moments which were caused aerodynamically. The jet tabs, as dynamic controls, were to correct any variable moments (rolling, elevation on azimuth).

The measurements of the Flettner characteristics, thus of the control moment c_L about the longitudinal axis and of the hinge moment c_r necessary for rotating the flaps, corresponded to what was expected (Fig. 11).

The character of the control moments revealed these to be independent of the projectile's angle of incidence. As the Flettner flaps are located at a considerable distance from the projectile, a slight displacement of the centre of pressure is of no great significance. At supersonic speeds at least, the control moment is therefore to be regarded as a measure of the normal flap force. This is not the case for subsonic speeds, as the control moment is influenced by the forces induced upon the empennage by the flaps. These can be fairly high in this speed zone. By comparing the two diagrams, it can all the same be seen that, at subsonic speeds, the point of impact on

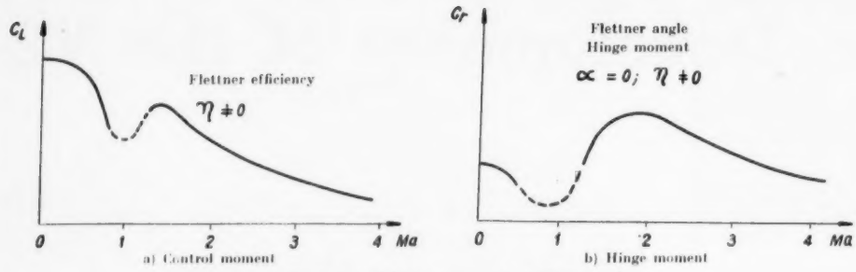


Fig. 11 : Control and hinge moment of Flettner flaps

the flaps is only slightly to the rear of the axis of rotation ; that it advances slightly at sonic speed ; and shifts well to the rear at supersonic speeds. The flaps' axis of rotation was situated at approximately 22 per cent. from the leading edge. The extraordinary increase in hinge moment at supersonic speeds was extremely unfavourable ; even by incorporating greatly different flap forms, it could not be influenced in any definite way.

It was thought that the jet tabs could be developed solely on the basis of combustion trials on the test bench. As they were subjected to an exactly determined flow, characterised by a constant Mach Number, it was easy to find a position of the axis for which the hinge moment was slight (Fig. 12). All tendency toward instability was corrected by springs. At large flap angles, it was impossible to avoid a sharp increase in moment, as the jet spread sideways and thus modified the characteristic.

At the beginning, it was found that after the jet had been functioning for some time, a considerable backwards displacement of the centre of pressure on the flaps occurred, causing the hinge moment to increase considerably. This was because the leading edge of the tab was burned off by the jet.

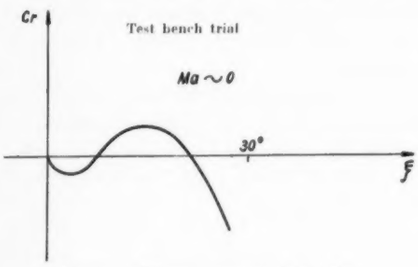


Fig. 12 : Hinge moment of jet tabs (ξ = tab angle of incidence)

By applying a suitable edge aft of the axis of rotation (Fig. 13), which burned off in the same manner, it was possible to confine this effect within reasonable limits.

Much later, the jet tabs' characteristic was measured in a wind tunnel : the results were very surprising. The wind tunnel tests involved a simulation of every flight condition, thus entailing considerable expense and complication. It was found that the jet tabs, too, were influenced to a great extent by altitude and speed.

Fig. 14 shows how the hinge moment first augments strongly with the Mach Number and later diminishes as the combustion ceases. Initially indifferent, the tabs definitely gain stability, which means that the centre of pressure shifts to the rear. This is caused by a " guiding " of the jet

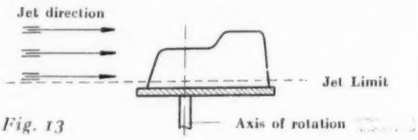


Fig. 13

by the exterior flow ; the guiding action augments strongly as the Mach Number and impact increase. For this reason, the jet can no longer deviate from the tabs and subjects their surfaces to strong forces, fairly evenly distributed. This effect does not diminish until high Mach Numbers are attained, for which the impact decreases because of the high altitude and reduced density of the air. Because of these effects, the hinge moment had to be much greater than originally thought.

It remains to be said that, for an exterior flow speed equal to zero, the test bench result more or less coincided with that obtained with the model in the wind tunnel. This fact was important, for it meant that the chain of proofs was complete and that the validity of the special tests in the wind tunnel was assured.

It was possible to calculate the azimuth and elevation control moments from the mechanics of flight data. The total requirements of the control moments, the efficiency of the control and the moments necessary to actuate it were made available as measured values. From the aerodynamic standpoint, therefore, the control problem was entirely clarified.

The development of the automatic pilot, so far restricted to purely functional trials on the test bench, executed under extremely intricate experimental conditions, could now be continued to a large extent in the laboratory. An " oscillating bench " was developed solely for this purpose. Electric devices permitted a complete simulation of every control and hinge moment, and enabled account to be taken of the inertia moments for the entire apparatus, the angular speeds and the accelerations, the damping moments and the wind influences. Thus, every condition of flight could be reproduced in function of time. Disturbing impulses could be created and every reaction of the automatic pilot studied accordingly.

Airframe Constructional Data

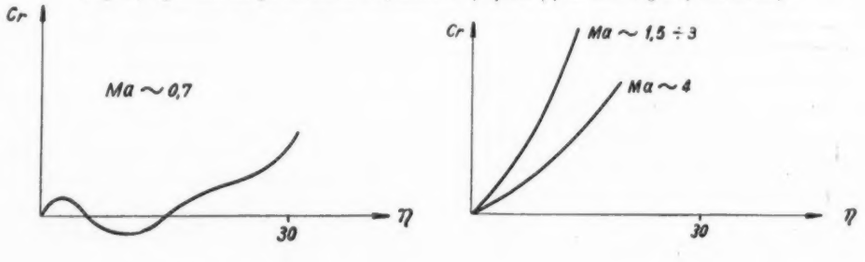
Detailed aerodynamic studies are of capital importance for the construction of aerial missiles. Whereas the constructional weight must be as low as possible, the projectile must fly with security and resist all possible loads. The basis for the solution of this problem is the determination of the pressure distribution.

Large-scale accurate tests of this kind were carried out for the first time, and hitherto for the only time, in the supersonic wind tunnel at Peenemünde. Solely for determining the pressure distribution on the V2, measurements were executed at some 120,000 points of the fuselage and empennage, divided over 17 rings and frames, and for five angles of incidence, three subsonic and four supersonic speeds. The tests and corresponding calculations required about 14,000 working hours. In order to show just how complete the diagrams thus obtained were, and to illustrate how the pressure at various points depended on the speed, Fig. 15 describes the pressure distribution for different rear fuselage rings and empennage frames.

The position of the measuring points on the fuselage and empennage can be seen from Fig. 16, which shows the normal force distribution over the entire projectile.

These constructional data are supplemented by the measurement of the pressure distribution for an angle of incidence of 0° (Fig. 4) and by the already-mentioned measurements on the jet tabs. Other, more special constructional problems could also be solved easily by pressure distribution measurements ; *e.g.*, at which point of the fuselage had one to aerate the fuel tank

Fig. 14 : Jet-tab hinge moments in function of speed (η = tab angle of incidence)



(which emptied continuously) in order that as feeble an overpressure as possible should occur, and in no case a depression ? Or, where on the exterior surface had one to place the aeration slits or holes in order that the fuselage interior should be subjected to a regular, but not too strong, air stream ? The last point was important because it was necessary to avoid an accumulation of fuel at the rear of the projectile, which would have caused an explosion. However, such an accumulation, caused by fuel pipes or pumps which were not hermetic, had always to be reckoned with.

In the serial production of the V2's, it turned out that the 0.5-mm steel sheeting, forming the outer skin, was not smooth, but frequently slightly corrugated. Thus the danger existed that the skin might refuse to oscillate, and consequently tear. Information in this connection was obtained by taking slow-motion pictures of corresponding projectiles in the wind tunnel. It was discovered that a dangerous tendency not to oscillate did exist, though only when the sheeting was subjected to equal pressures from both sides. As a result, the projectile was partitioned, with corresponding aeration.

In view of the friction at high speeds, considerable heating of the skin was to be expected. Calculations based on measured coefficients of heat transmission gave a temperature curve in function of time which corresponded approximately to Fig. 17.

The temperature drop after leaving the atmosphere (the two vertical lines) does not signify a continuous diminution of the boundary layer temperature. As is known, the temperature is determined by the equilibrium between the absorption of the heat (which depends on the density of the air and the speed) and of the radiation. Consequently, the coefficients of heat transmission are very small outside the atmosphere because the air density is extremely low. In contrast, however, the radiation is more effective.

Hence, complete data had also been obtained for this part of the work, and there existed the assurance that all constructional problems would be solved.

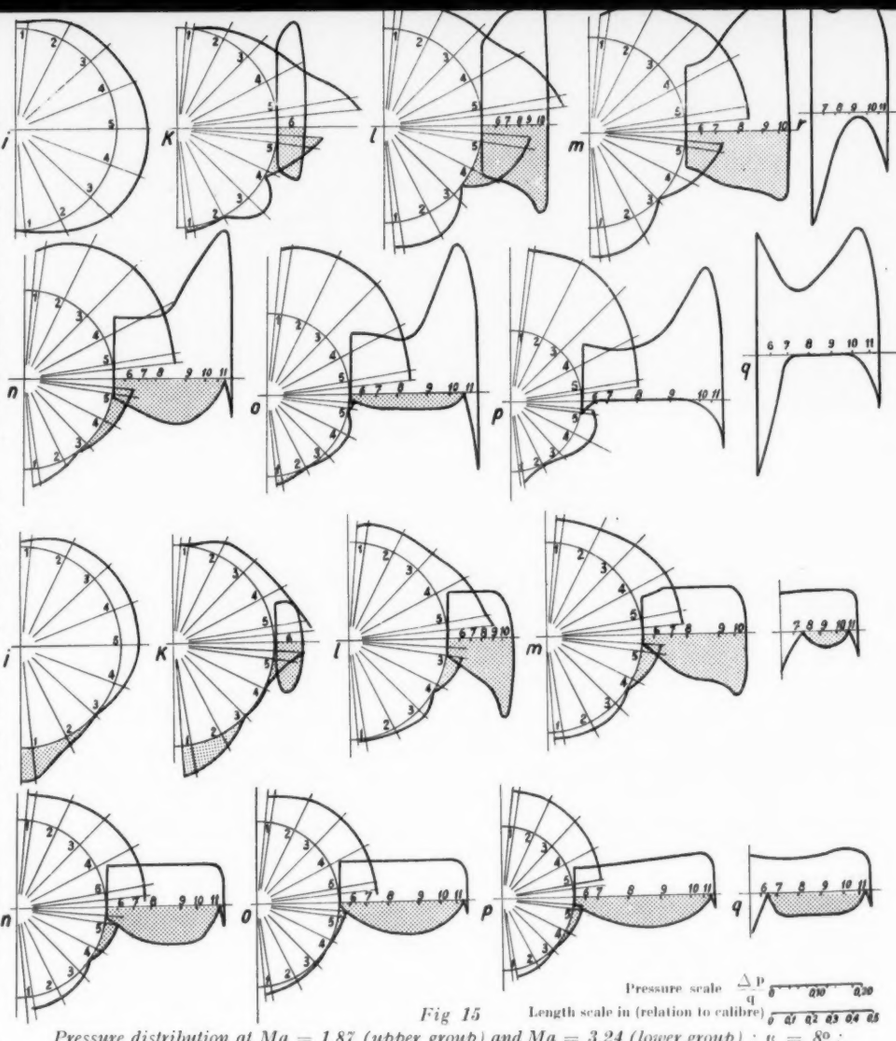


Fig 15 *Pressure distribution at Ma = 1.87 (upper group) and Ma = 3.24 (lower group) ; α = 8° ; shaded surfaces = positive values.*

Free Flight Tests

The free flight trials, giving rise to great interest all round, were planned long in advance, prepared thoroughly and very carefully carried through. These trials all the same constituted the touchstone for the entire project, as well as for the partial developments. In order to obtain definite and satisfactory results, extremely extensive measuring equipment and an enormous amount of organisation was necessary ; this becomes evident when one realises that contact had to be established between the point of departure and the various observation stations along the trajectory and around the target area located 300 km away.

Originally, the trials were only made in Peenemünde, firing parallel to the coast in the direction of the Hela peninsula, near Danzig. The theoretical target area lay in the sea, about 20 km off the coast. Later on, notably for the training of future military units, tests were also conducted in Poland, with the target areas in districts which were overrun by partisans. It is interesting to note in this connection that the personnel stationed at the target end were often shot at by snipers, but that most of the victims were civilians and seldom soldiers or officers. It is pretty certain, therefore, that these snipers were well aware of the nature and purpose behind the tests.

Something new and entirely unexpected was discovered, namely the extraordinary effect of even blank trial projectiles when they landed. There was an explosive reaction which corresponded roughly to that of a 5,500-kg. bomb. In this connection it was believed that the large, empty fuel tank (about 10 cu.m. capacity), hitting the earth at a speed of 1,000 m/sec., exploded just as an inflated paper bag bursts when one pops it. The explosion of the remaining fuel and oxygen probably also contributed towards this effect.

The measurements were decomposed as follows :

1. Measurement proper of the projectile by means of transmitting equipment.
2. Measuring the projectile from the ground by means of Wohlmann and Würzburg-Riese transmitters.
3. Measurement with cinematographic theodolites.
4. Location of the point of impact by acoustical methods and water coloration.
5. Observation with telescopes and cinecameras.

The measurement transmitter was built into the projectile. It wirelessed continuous information on four measuring points at first, and later on twelve. In this way it was possible to obtain continuous information on temperature and pressure from any points inside the missile and on its exterior surface. It gave a method of controlling the angle of incidence, the functioning of the automatic pilot, the jet tabs, the fuel pumps and the combustion chamber, as well as inherent

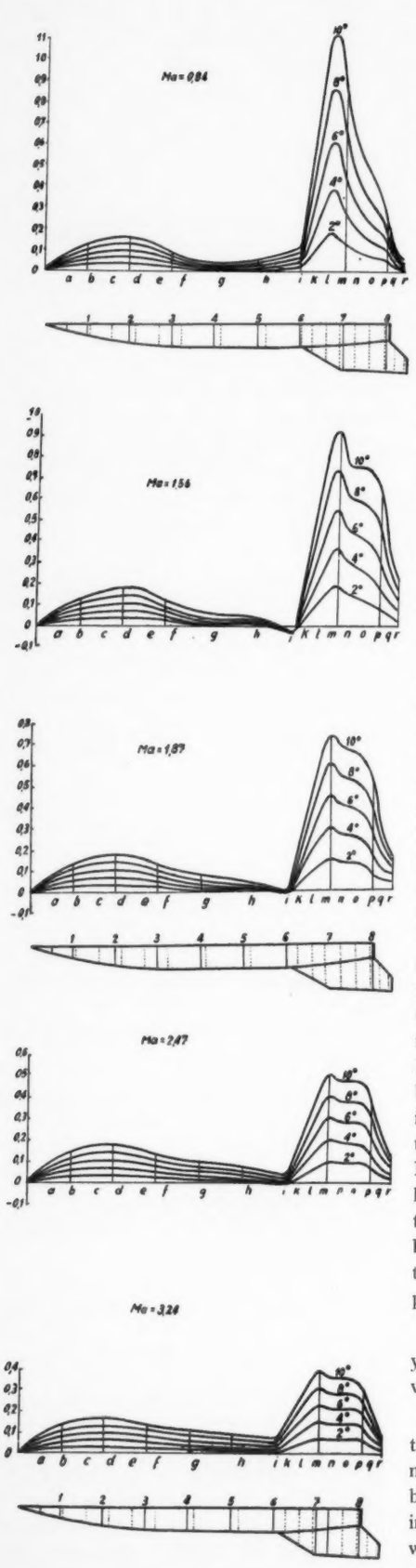


Fig. 16
Normal force distribution at different angles of incidence and Mach Numbers. Abscissa = non-dimensional lateral force coefficients.

oscillations or vibrations of separate components. The measurement transmitter, developed specially for the purpose, contributed decisively towards the efficacity of the tests and enabled the observations to be used to their fullest advantage. It constituted the only way in which the internal functioning of the V 2 could be examined.

The Wohlmann transmitter, likewise built specially for the purpose, enabled excellent observations to be made of the entire trajectory, from the take-off to the arrival at the target. It gave the exact character, in function of time, of the flight speed, flight direction, eventual rotation about the longitudinal axis, and the firing range, and therefore constituted a perfect supplement to the measurement transmitter.

The functioning of the Wohlmann transmitter is based on the electrical Doppler effect. A short-wave, stabilised with quartz, was transmitted over a dipole antenna, received by the V2, amplified, transmitted again, and once more received by the ground station. Due to the speed of the V 2, the returning frequency was lowered ; by superimposition of the original shortwave and the one received again, oscillations were produced whose frequency was proportional to the speed of the V 2. A suitable choice of the transmission frequency by the ground station enabled the oscillation frequency to lie within the acoustic zone. In this way loudspeakers permitted all observers in the various stations to " listen " to the speed at the same time as they observed the trajectory. The fact that the shortwave was captured and re-transmitted by the projectile enabled the carrier frequency to be varied to a great extent, as if it had concerned a simple reflection such as in radar and Würzburg-Riese equipment. This was significant because the V 2 carried the first transmitter in the history of high-frequency technique to have flown above the Heaviside layer. For this reason, very disturbing reflections had to be taken into account. By measuring the phase displacement of the modulation between the transmitted and received waves, the Wohlmann transmitter also enabled precise distance calculations to be effected.

Thus, in this field also, the free flight tests yielded the first scientific data, which were very valuable.

By measuring the duration of the wave the distance of the missile could be determined ; and its direction could be found out by taking a radio bearing of the maximum intensity. As the transmission and reception was effected with dipole antenae, the intensity of the received wave depended on the azimuth position of the V 2 in relation to the ground station. Any rotation about the longitudinal axis caused a periodic squeezing of the reception amplitude, which was called the " sausage effect. " In this way the twist frequency could be determined very exactly.

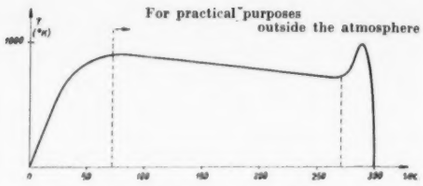


Fig. 17 - Skin temperature in function of time.

The Wohlmann transmitter worked very reliably. It often came to the rescue, giving valuable results when the other measuring equipment failed because of bad weather conditions or other disturbances.

The Würzburg-Riese transmitter, which worked on the radar principle, did not turn out to be very useful for measuring the trajectory. Its range was inadequate, and if a projectile happened to be lost, it was hardly ever possible, in view of the high speed, to find it again. Moreover, bearings taken from the ground station in order to follow the last part of the trajectory were seldom successful.

The method of measuring with a cinematographic theodilite, starting from a large triangular base, is fairly widely known and requires no further explanation. Because of the limited optics and the smallness of the image, these measurements were naturally only of value for the very first part of the trajectory.

The location of the point of impact was carried out in the target area by acoustical methods from the shore or from ships. In addition, an intense green dyestuff was used to colour the water, thus making it easy to spot the point of impact from an aeroplane. The Wohlmann transmitter was used to determine the point of impact from the firing station ; and the moment at which it occurred could be ascertained very precisely in view of the disappearance of the reception wave.

The projectile was filmed through a telescopic lens mounted on a conventional cine-camera. This was primarily to support and complete the subjective observations of the trajectory, and was particularly useful for clarifying any divergencies of opinion of the various observers. Colour films were used in the majority of cases. A reproduction in colour was very often of great value, as the coloration of the ignited jet stream, or eventual smoke clouds, enabled one to observe the combustion and its irregularities.

Great value was attached to subjective observation by the ground personnel. Under good visibility conditions, and with telescopes of 15-50 fold magnification, it was easy to follow the trajectory until the combustion ended, and sometimes even longer. The longest observation made by the author was on a clear day with an

astronomical telescope magnifying fiftyfold ; this lasted 115 seconds, which corresponds roughly to the same number of kilometres. Subjective observations constituted a valuable supplement to the measurements. Any tearing-off of the skin, detachment of the empennage, or tail explosions, could be watched. In this way valuable clues could be obtained as to the causes of faulty take-offs or abnormal behaviour, which the other measuring systems could not supply. The principle command posts and observation stations were equipped with television receivers which showed the V 2 during the take-off and allowed the actual take-off to be followed from considerable distances. Once the projectile had risen above the forest, it could be followed by visual reference with the telescope. A loudspeaker counted the seconds and transmitted the " sound of the speed " obtained from the Wohlmann transmitter. This gave the observer an excellent relationship between what he saw, what he knew ought to happen during the flight, and the projectile's speed. Secretaries noted down the observers' remarks, each time marking the hour. The piercing of the sonic barrier, followed with particular interest from the aerodynamic standpoint, revealed no anomaly whatsoever.

During these tests an ever-increasing number of projectiles burst in the air a few seconds before attaining the target, after having described a perfect trajectory. In consequence, the need arose to follow the projectile directly from the take-off until the impact. This led to the vertical firing position : the automatic pilot was set for an absolutely vertical trajectory instead of the normal flight progress. This involved no danger for the observation and firing personnel as the fact that the earth turned beneath the projectile during the latter's five-minute flight up to an altitude of about 120 km, meant that it had to fall into the sea at a point approximately 10 km west of where it took off. However, the vertical flight alone was not sufficient to make the missile visible along its entire trajectory ; it was frequently not possible to see it at 30-50 km altitude, and it could not be found again after it had fallen. A very elegant solution was found to this problem : the projectiles were painted bright yellow and fired about one hour after sunset. There was still sufficient visibility for the 14-m missile to be seen from very great distances. In addition, the dusk enabled the eye to adapt itself to the poor visibility, thus widening the pupil so that a great amount of light could pass. The missile left the shadow of the earth shortly before the combustion ended, and was brightly illuminated by the sun. It then resembled a comet and was perfectly visible right to the summit of its trajectory.

It was possible, later, with such take-offs at dusk, to follow normal trajectories in their entirety, partly from the take-off point and partly from the target area, with overlapping observations. As far as was possible the free flight tests confirmed all the aerodynamic hypotheses. This also applied to the variations in temperature which had been calculated ; these could be controlled by the measurements by fusible contacts, transmitted by the measurement transmitter, and also by the annealing colours on fallen missiles. In this way, numerous projectiles which had burst in the air could be examined. Measures could be taken to eliminate the supposed causes—of which there were a great many—and it was consequently possible to reduce the number of these occurrences, though they could never be stopped entirely.

The few people who had the privilege of watching one of these free flights through a telescope, experienced something truly fantastic. It is quite impossible to forget the spectacle of one of these slender and imposing rockets taking off after sundown, climbing out of the earth's shadow into the light of the sun, continuing in mathematically straight flight towards the zenith, remaining there, immobile for a moment, then re-descending tail first to turn about suddenly as it entered the atmosphere, oscillating slightly, and then plunging like an arrow into the sea, almost without a splash.

"BELPHÉGOR"

By Fernand HUET, Department Chief, SNCA du Centre

The research division of the Société Nationale de Constructions Aéronautiques du Centre has been working on the development of an experimental aircraft for stratospheric flying for some time already. During the German occupation the project was continued at the concern's plant in Cannes and ultimately gave birth to a prototype. This bore the designation of SO 3020 " Belphégor ".

After the cessation of hostilities, Aérocentre's technical services were resumed and, following the choice of another type of engine, the aircraft was redesignated as the NC 3021.

Designed for altitude flying at 33,000 to 46,000 feet, the " Belphégor " is for research on meteorology and cosmic ray phenomena.

It is hoped that these experiments will clarify the various problems presented by stratospheric flight, notably in connection with the airframe, power plant, and pressure cabin.

In order that it may fulfil its mission satisfactorily, it is evident that the aircraft must be able to stay in the stratosphere for a sufficient length of time. On cruising power, the " Belphégor " can fly in the stratosphere for about seven hours.

Originally it was intended that the NC 3021 should be fitted with two Hispano-Suiza 12Z liquid-cooled twelve-cylinder in-line engines with Turboméca superchargers for a rated boost altitude of 26,200 feet. However, delivery of the Hispano engine entailed difficulties, so that it was replaced with a Daimler-Benz DB 610 liquid-cooled 24-cylinder double engine (two Daimler-Benz DB 605 12-cylinder in-lines joined side-by-side), with a common airscrew reduction gear.

The prototype NC 3021 undertook its first flight on June 6th, 1946, over Toussus-le-Noble airfield.

Note the sharp increase in thickness towards the roots.

Structure :

The NC 3021 is a cantilever mid-wing monoplane with a circular-section fuselage of which the upper side is slightly flattened in order to afford the pilot the best possible visibility conditions. As the slender trapezoidal wing, in view of its small absolute thickness, would only have allowed for relatively weak attachment points with the fuselage, it was found necessary, for constructional reasons, to increase the wing chord and profile thickness at the roots. The incorporation of this design feature enabled the main landing wheels to be retracted into the wing roots and two large-capacity fuel tanks to be housed there also. Quite apart from this, very good aerodynamic qualities were revealed during the course of the test flights.

A satisfactory compromise between a maximum degree of aerodynamic refinement and a minimum of constructional weight was achieved by incorporating a wing of 538 sq.ft. in area and an aspect ratio of 10.

Wing :

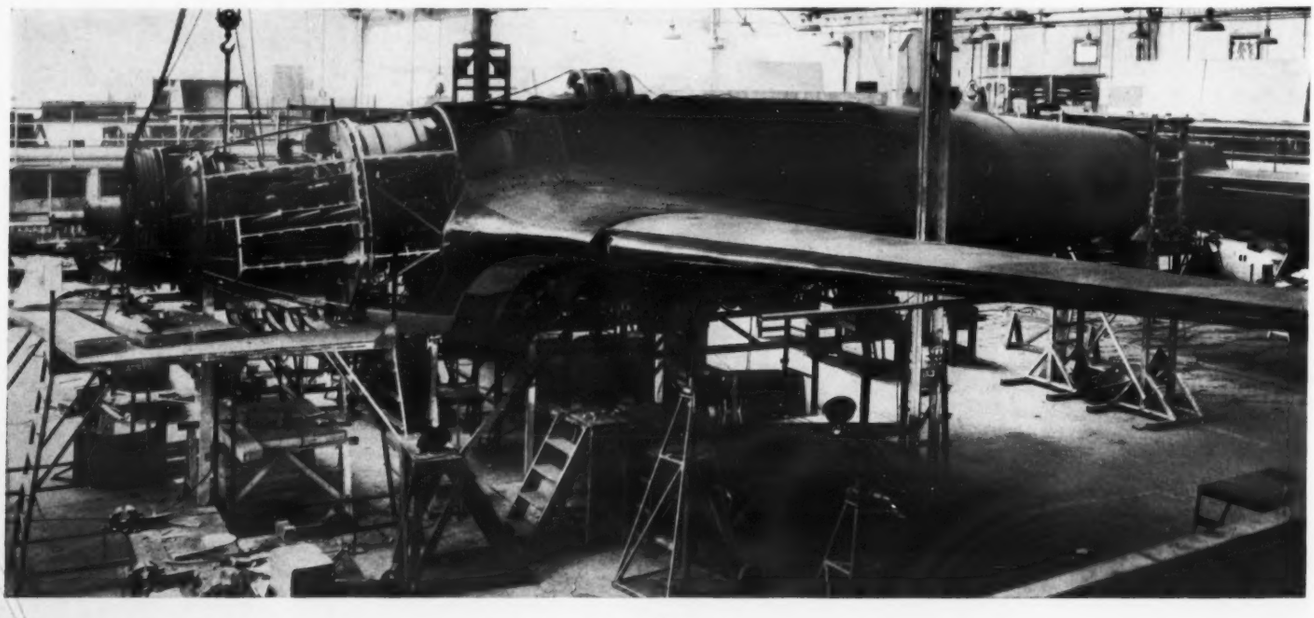
The four-section wing consists of slender trapezoidal outer wings with rounded tips, and two parts forming the centre section of progressively increasing thickness and chord. The single-spar all-metal centre section has a main spar which is composed of steel and duraluminium booms and a light-alloy plate web of the same thickness as the boom members. The rear and front auxiliary spars are of light alloy with plate webs. The connection between the booms and the skin (stiffened by longitudinal stringers) is achieved by means of angle-sections. The ribs, skin, and main and rear auxiliary spars, together form a torsion box. In order that the latter should not be weakened, the wells for the main wheels (retracting upwards and inwards) are located between the front and rear auxiliary spars. The remaining space inside the wing centre section is allocated to fuel tanks.

The likewise single-spar outer wings are of composite structure and comprise, in addition to a light-alloy main spar with a plate web, the forward and rear auxiliary box spars ; the auxiliary spars, built of wood, have spruce booms and plywood webs ; and together with the main spar, they carry the wooden girder ribs. The leading edges, screwed to the wing, contain the thermal de-icing system. Both the centre section and the outer wings have all-metal camber flaps. The ailerons, however, are fabric-covered.

Fuselage and Pressure Cabin :

The fuselage breaks down into three unit components : the nose portion with the power plant ; the centre portion with the pressure cabin ; and the rear portion. The aircraft's operational efficiency is, of course, largely contingent on the quality of the pressure cabin.

NC 3021 " Belphegor " under construction. The Daimler-Benz DB 610 double engine is borne by a steel-tube structure aft of a honeycomb radiator ; the entire centre section of the fuselage is occupied by the pressure cabin, of which the dorsal and ventral observation windows are visible in the photo.



This becomes all the more evident, as the pressure cabin more or less constitutes the heart of the entire aircraft and contains all the essential control equipment as well as the pilot's station.

Located in the upper part of the fuselage centre portion, the pressure cabin essentially consists of a light-alloy cylinder of 5 ft. 7 in. in diameter and about 415 cu.ft. in volume, with a hemispherical front wall and a concave rear wall. Access is by a door in the rear wall, which opens inwards and otherwise seals the cabin hermetically.

The pressure cabin is sealed off from the outer air by the fuselage skin as well as by its own walls. The arrangement provides good heat insulation ; and its effect is further enhanced by the introduction of an insulation medium between the two walls. Moreover, it is also possible to establish any desired temperature in the cabin by heating up the layer of air between the two walls. A heating system, deriving its energy from the exhaust gases, can be regulated to give interior temperatures of 59° to 68° F. The hot air is carefully led to numerous points of the cabin, notably to the canopy above the pilot's seat, the points where control rods and cables pierce the walls of the pressure cabin, and to the automatic valves located in the cabin walls. The regulation of the temperature is effected electrically.

The pressure cabin is of welded Alumag sheet and stiffened on the exterior by riveted lateral and longitudinal structural members as well as by the duraluminium frames and longerons of the fuselage centre portion. The frames and longerons serve to hold the skin and are also used to provide a connection between the fuselage centre portion and the other unit components of the aircraft. Thus it can be seen in Fig. 3 that the main frame has fittings to which the main wing spar is attached, and that it is connected through a curved boom to the pressure cabin.

In order to facilitate supervision, maintenance and access to the outer walls of the pressure cabin, the fuselage panels are made detachable.

A dorsal superstructure, consisting of a semi-cylindrical metal part closed off to the fore and the rear by spherical sections of plexiglass, permits an unrestricted view on all sides. A similarly designed observation station is located on the lower side of the pressure cabin. Whereas the dorsal superstructure forms a protuberance, the lower observation station is housed entirely within the fuselage. The fuselage belly is suitably fitted with plexiglass windows, thus providing adequate ground visibility for the execution of wind-drift measurements with cine-cameras.

Constructional problems regarding the sealing of the pressure cabin (*e. g.* the adaptation of windows and observation stations ; the necessary placing of the control rods through the wall) had already been solved in earlier experiments conducted by SNCAC. The instruments and the extensive auxiliary equipment work electrically, so that the necessity for passing servo cables through the walls has been cut down to a minimum.

Two cabin blowers (NC 41 type) are coupled to the engine and provide the necessary ventilation and cabin pressurisation. Each blower supplies 14 cu.ft. of air per minute at an altitude of 39,500 ft.

Two automatic valves regulate the pressure in the cabin : up to an altitude of 42,700 ft. an interior pressure corresponding to 8,200 ft. can be maintained. Should it be required that a member of the crew bale out, an emergency valve located on the entrance door enables the pressure to be re-established in a minimum of time.

The ventilation system, connected directly with the outer air and entirely independent of the pressurisation plant, supplies the cabin with fresh air during flights at low altitudes and high outer temperatures.

The cabin is divided into two compartments by a wall fitted with windows. The first compartment is for the crew and contains the pilot's seat to the fore. The navigation equipment is behind and to the right of the pilot's seat, and the radio equipment to the left. The second compartment, which actually constitutes a laboratory, contains the necessary research equipment, two seats, a desk and a lavatory. The already-mentioned ventral observation station is beneath the cabin floor and is reached through two hatches.

The *nose portion* of the fuselage is of welded chromium-molybdenum steel-tube construction with Dural skin and contains the two main fuel tanks which are directly in front of the pressure cabin.

The *rear portion* is built up of spruce frames and longerons with plywood skin. The empennage and tail-wheel are supported by two frames reinforced with metal fittings. Together with the skin these form a constructional unit proper, which is bolted to the rear portion of the fuselage. When retracted, the tail wheel lies between these two frames.

Empennage :

The fin and tailplane are of wood, and the rudder and elevators of fabric-covered metal framework. The single fin and rudder unit embodies a dorsal fillet. Incidentally, this is not featured in the photos and G.A. drawing as its incorporation was only decided on after the test flights.

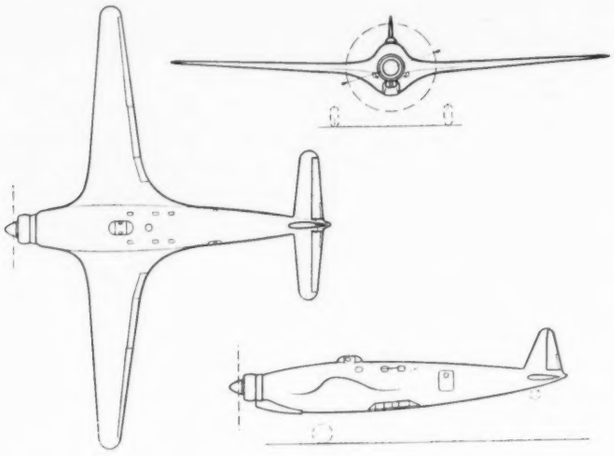
The rudder and elevators are actuated by means of control rods and cables, the rods leading from the pilot's seat, through the cabin wall, and then joining on to the cables. Cables are likewise used to work the rudder and elevator trimming tabs. The equipment of the " Belphégor " also includes an automatic pilot.

Undercarriage :

The undercarriage is of conventional design and fully retractable. The main wheels are mounted on massive shock-struts and the tail-wheel is steerable ; all three retract hydraulically.

Cockpit, with the pilot's seat removed to provide a better view.

Visible are the dorsal and ventral observation stations, and the plexiglass panels located under the fuselage.



SPECIFICATIONS

Main Dimensions

Span	73.23 ft.
Length	56.07 ft.
Height	19.13 ft.

Wing

Wing area	558 sq. ft.
Aspect ratio	10
Tip profile thickness	10 per cent

Fuselage

Max. height	8.60 ft.
Max. width	7.55 ft.
Max. sectional area	50.9 sq. ft.
Pressure cabin : Diameter	5.58 ft.
Length	17.06 ft.
Volume	415.3 cu. ft.

Empennage

Elevator Unit :	
Span	24.61 ft.
Total area	105 sq. ft.
Fin and Rudder Unit :	
Height	7.91 ft.
Area	37.7 sq. ft.

Undercarriage

Main wheel diameter	94.9 in.
Tail-wheel diameter	20.1 in.

Power Plant

One Daimler-Benz DB 610A liquid-cooled 24-cylinder vertical in-line double engine :

Take-off power	2,910 H.P. at 2,800 r.p.m.
Output at 37,000 ft.	1,104 H.P. at 2,300 r.p.m.
Fuel supply	559 Imp. gals.
Oil supply	40.7 Imp. gals.
Diameter of four-blade c.p. airscrew	14.7 ft.

Weight Distribution

Tare weight	17,262 lbs.
Disposable load	5,566 lbs.
Gross weight	22,928 lbs.
Wing loading	48.6 lb./sq. ft.
Power loading at take-off	7.89 lb./H.P.

Design Performance

Max. speed at 23,000 ft.	373 m.p.h.
Cruising speed at 37,000 ft.	311 m.p.h.
Time to climb to 37,000 ft.	38 min.
Optimum ceiling	44,300 ft.
Take-off distance	470 yds.
Take-off distance over 26-ft. screen	690 yds.

The Helicopter and Stability

By Arthur M. YOUNG, Chief Development Engineer, Helicopter Division, Bell Aircraft Corp., Buffalo, N.Y.

Since the helicopter began, it has been represented by a great variety of forms. No one knows what will finally emerge as the most useful solution and it is probable that designers will for some time to come want to try more than one type. In what follows I am going to review eighteen years of struggle with the helicopter problem. I want to show not only how I came to rest on the two-bladed rotor and how the problem of stability presented itself, but more generally some of the errors inherent in my first approach. It is for this reason that I go into my past history, since the errors I made may be made again if no warnings are set out. The final solution was one to which I was forced by the difficulties that presented themselves as the evolution continued. The reader will also note the emergence of a technique which, much as the "fruit fly" is used in biological research, was used to speed up the evolution of a practical design.

Sometimes progress was made by sudden mutations, sometimes by logical improvement, and sometimes by environmental pressure. But as time passed, a new concept of the problem emerged. The helicopter would have to *evolve*. Once this was accepted, the use of simplified flying models as a technique for testing ideas was constantly resorted to. Through this technique a design finally emerged which bore no resemblance to initial design. This design is the direct ancestor of the present Bell Model 47.

Part I — First Trials and Errors

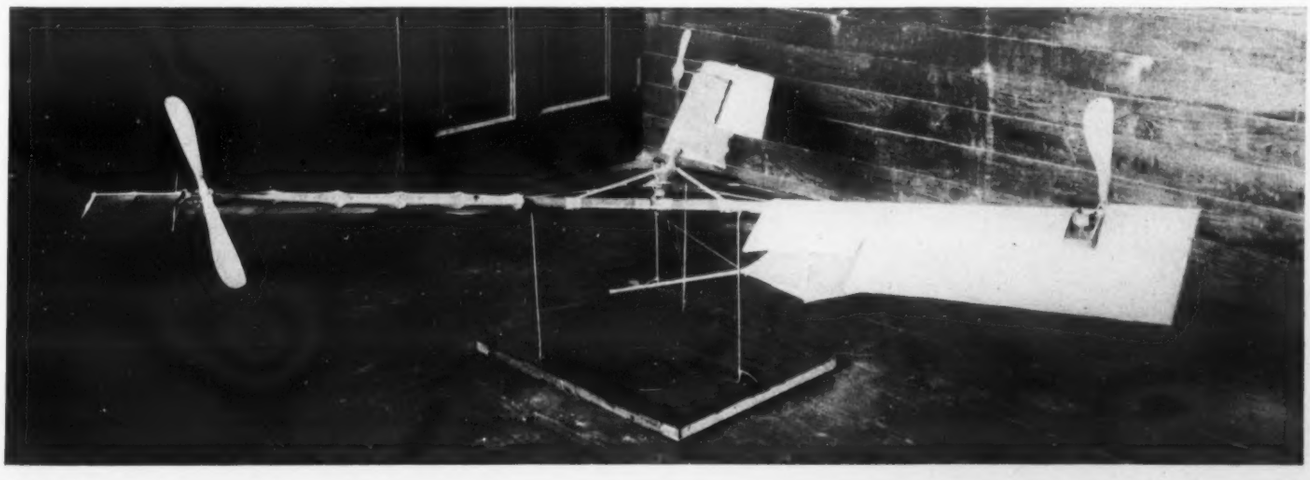
The real problems of the helicopter did not make themselves known to me at first. The problem of lift, for example, received the most attention. The helicopter, I reasoned, is in essence a rotating air screw. It must be of sufficient size and power to obtain the thrust necessary to lift the machine, plus as great a load as possible. Horsepower must be transformed into lift. Lamé, [1] citing the work of Magroulis, established relationships which clearly showed why the lifting possibilities of air screws were limited by the diameter and the horsepower. Stated simply, lift is proportional to the 2/3 power of the horsepower and diameter. This fundamental principle exposed the fallacy of many early workers who planned a full-scale machine on the basis of tests with models, in which sometimes more than 40 lbs. per horsepower was obtained. While Lamé stated this principle for helicopters, it was also clear from the laws of propellers stating that the thrust of a propeller is proportional to the square of the r.p.m., and the power to the cube of the r.p.m. Algebraic substitution nets the result that the thrust will be proportional only to the 2/3 power of the power. Therefore, increase of power does not proportionately increase lift. *

So we are driven to the conclusion that the helicopter must deal with large rotor diameters and large horsepowers. Therefore, our first problem is to turn as large a rotor with as much horsepower as possible for a given weight. Since gears and shafts are lightest when r.p.m. is greatest, high speeds of moving parts must be favoured. Advantage must be taken of every possible means to get the great strength and power for a given weight.

The next problem is that of correcting the torque. There were, I reasoned from a review of the great variety of helicopters that had been proposed, a number of different ways of answering this problem. At that time the solution favoured by Isacco, of having small propellers at the blade tips drive a large rotor, appealed to me, for the reason that there was no torque to correct. I preferred, however, to place the engine in the fuselage, and avoid the difficulties of getting fuel, lubrication, controls, and so forth, to engines operating under the severe centrifugal force which Isacco had to deal with. To drive the small propellers without

*) Cf. Derivation of the Bendemann Formula in Dr. Walter Just's article on "Performance Calculation for Helicopters," "Interavia Review" No. 3, March, 1947, P. 35: equations (1) to (4). — Editor.

Fig. 1 : Rubber band model—used in 1929 to check forward speed (note ailerons and cyclic crank)



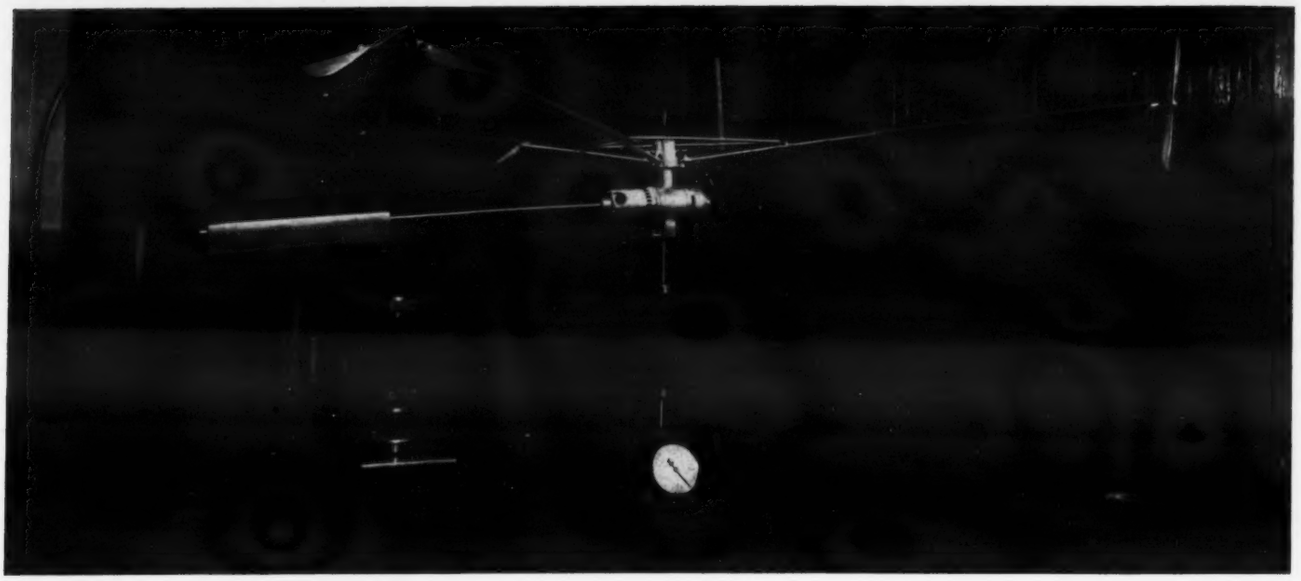


Fig. 2 Electric model turned by small propellers on tips of large propeller

torque reaction on the fuselage, I devised a gear which transmitted the torque to the small propellers in such manner as to react it on the large air screws instead of the fuselage. (U.S. Pat. No. 1,915,209).

The problem of forward speed was studied with models and with the whirling arm, and seemed to present no difficulties. The device of feathering the advancing blade as per Perry, Isacco, and Pescara, worked perfectly, both on the whirling arm and with models. The models used (Figs. 1 & 2) had no fuselage, however, so the problems which arise with a pendular fuselage did not come up. Since the centre of gravity was thus near the rotor centre, instability did not develop for reasons which will be seen later.

So the next step was a full-scale machine. Finding that backers were too impatient to live through the long development I anticipated—everyone wanted a quick return for their money—I decided I would have to do it myself, but a full-scale machine was beyond my financial means. I could, however, manage something small, built around, say, a 20-horsepower outboard motor. (This turned out to be a poor decision.) With this power the machine could either have a large rotor, or a small one : the first would supply greater lift, perhaps enough to carry a passenger. The small machine, however, would entail more severe stresses, since the small diameter rotor would have to revolve at much higher r.p.m. and hence accentuate the stress problem. Since the stress problem, and the related problem of the best use of a given weight of material was *the* problem of the helicopter, it would be better in the long run to make the machine with the high power loading, so that the stress problem could be given prominence at the onset.

This was logical but erroneous ; the error lay in assuming that the configuration was satisfactory in flight. Stress, however important, must be set aside until the configuration and proportion have been established by flight. I decided a passenger was not necessary since when the question of flight came up, remote controls could be incorporated.

By such inexorable logic I was driven on. For some seven years I built and rebuilt this Frankenstein. It consisted of a three-bladed ten-foot diameter main rotor driven by small propellers at the blade tips. A 20-horsepower outboard motor drove the small propellers through long shafts inside the blades connecting to bevel gear boxes at the blade tips. The small propellers turned at 4,800 r.p.m. and at the large rotor at 420 r.p.m. Centrifugal force at the blade tips amounted to some 450 G and the results were what one would expect. The machine blew up under centrifugal force, not only once, but many times. First the small propeller blades broke off at the roots, then the whole propeller twisted off the shafts. Finally the main blade itself parted company. Each time, of course, the parts were redesigned, until finally I was forced to such expedients as making a profiling machine to machine small propeller blades from hand-forged magnesium blanks.

During all these tests my attitude toward the ultimate result was one of sublime faith in the possibility of controlled flights, once I could get the machine to hold together under full load. Such was this unquestioning faith that I equipped the whole machine with remote controls. These were arranged through a multi-strand cable running to reversible electric motors. As this was in 1934, 1935 and 1936, before the advent of remote controls in aeroplanes, I encountered a development problem and had to devise slip clutches in the motor drives to prevent stalling the motors. Various other devices, fan, water pump and radiator for the outboard motor, oil pump for the gears, an over-torque clutch that would disengage when the outboard motor backfired or received its initial high acceleration, were necessities and had to function with nicety. However, no flights were obtained. Its last brief run was a 30 per cent. overspead test which it withstood for 20 seconds before blowing up.

I felt that the design was at last adequate, since the failure had occurred at a faulty weld. But the spell was broken. I realised that I was tackling the helicopter problem the wrong way.

Retrospectively, in the above there is nothing illogical. The problem is broken down into parts ; each one is tackled on its own merits. But there are errors.

(1) The question of flight is ignored, or postponed. This should have been the first consideration since it is the touchstone by which all other questions are judged.

(2) There is a confusion as to the purpose of the experiments. The fundamental purpose should have been to fly something. Time spent on special devices, such as were required to make the outboard motor practical, is time wasted because it delays basic development and would not be of value to a final machine.

(To be concluded next month.)

FIDO

versus

FOG

Year by year, fog, the deadliest enemy of every form of flying, claims its victims. Commercial and military transport planes are repeatedly crashing into mountains ; private flyers lose their way over unfamiliar territories, crash or, at the best, manage to effect an emergency landing. Ground mist, usually impredictable, can completely enshroud an airfield within a few minutes, or cut off the exit for an aeroplane lost in mountainous regions.

Regularity is one of the first requirements demanded of scheduled air operations. Radio aids to navigation have been developed to such an extent that today it is possible to lead any aircraft very safely to within a small distance from the runway ; but the final touch-down must still be made by visual reference. In a case of thick ground mist neither the air traffic controller nor the pilot can risk a landing, so that flights usually have to be cancelled or interrupted.

Ever since established airfields have existed, meteorologists, chemists and physicists in all countries have sought an efficacious means of combating fog. This treacherous enemy to all-weather flying has undoubtedly caused more headaches than any other obstacle, and still today we are far from having conquered it.

During the war, when little importance was attached to money and all that counted was that simultaneous air attacks by several squadrons from different bases should proceed exactly as planned, a method was feverishly sought which would enable at least the runways to be cleared of fog.

In England, where fog occurs rather frequently, various fog clearance systems were tried out during the initial stages of the war.

Only one of these has so far proved useful : FIDO (Fog Investigation Dispersal Operation), which involves heating the air alongside the approach path and runway by open combustion of liquid fuels. However, the operating costs of this system are exhorbitant : between four and five thousand dollars is the estimated cost of landing one single aeroplane. Though prohibitively high for profit-conscious airline operators, this sum appeared small when compared with the combat value of a long-range bomber.

During its stay in England the U. S. Army Air Forces had an opportunity to acquaint itself with FIDO and, already in the summer of 1944, installed the system at the fog-bound Amchitka air base in the Aleutians.

The war ended, and the new problem arose of how to apply FIDO to peace-time operations.

In one of the foggiest spots of the U. S. A. — Arcata, California — every conceivable system for making all-weather flying possible is being tested at the Landing Aids Experiment Station. The Army and Navy, Civil Aeronautics Administration, Civil Aeronautics Board, Air Transport Association of America, and United Air Lines are all collaborating in this extensive scheme. During the past two years the Arcata station has developed an improved FIDO system which, though still expensive to operate, seems to show promise of having commercial value in civil aviation.

A wartime emergency device has thus reached a stage of engineered perfection. However, its commercial future depends primarily on a project to install a prototype system at Los Angeles Airport. The cost of this installation is estimated at about $ 400,000, and it still remains for Congress to decide whether it will appropriate this amount. The manufacturers feel sure that the Los Angeles prototype system will furnish a proof of FIDO's utility, and that results will be such that additional installations will ensue at other major air terminals.

Thanks to the improvements incorporated in the Arcata system, the fuel costs, once unbearably high, are now down to about $ 25 a minute (based on U. S. fuel prices). In one test the FIDO burners were not ignited until the aircraft was coming down the approach path on instruments, and the total fuel costs of the landing did not exceed $ 50.

It would appear from these figures that, provided FIDO enables airlines to keep to schedule in all weathers and eliminates the necessity of cancelling or delaying flights, its costs are not extravagant.

In the experiments in England and earlier on in the U. S. A. various types of low-pressure burner and simple rotary pumps were used, but the installation at Arcata incorporates a high-pressure system, developed by the U. S. firm of *Babcock and Wilcox Co.* The main disadvantage of the earlier systems,

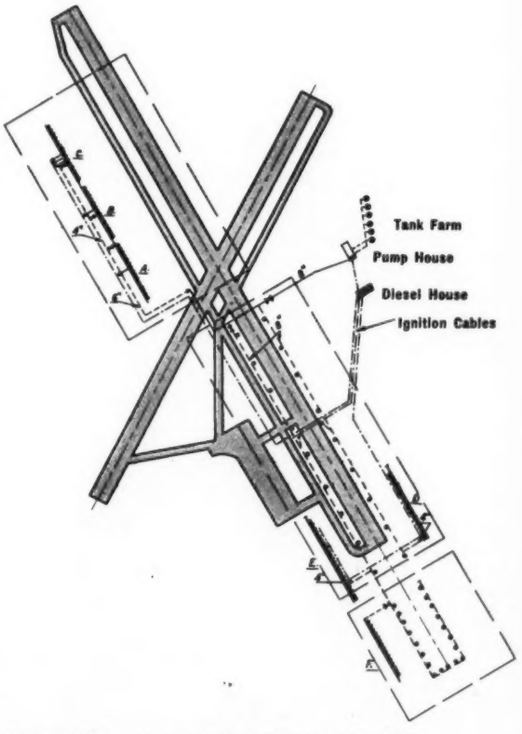


Fig. 1 : FIDO system along the instrument path at the Landing Aids Experiment Station, Arcata, California. Triad burners are located on either side of the runway and in the approach zone ; the six additional groups situated further away consist of single-nozzle burners arranged crosswise.

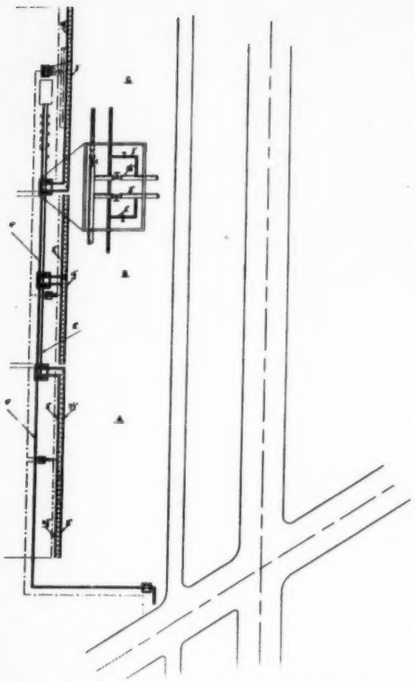


Fig. 2 : Supply lines to burner groups A, B and C.

in which the fuel was vaporised in a pre-heater and then burned in a separate burner tube, was that ten to fifteen minutes were required before optimum heat was reached. Furthermore, the installation involved very costly and complicated plumbing. Besides the high rate of fuel consumption, another drawback of former systems with pre-vaporisation was the burner's tendency to produce intense blue flames, creating high localised temperatures and strong convection currents which failed to give complete clearance of the runway.

The flames produced by the high-pressure burners are larger and less intense, with the result that not only is a comparably larger segment of the ground air heated, but a more efficient radiation is also achieved. The FIDO system at Arcata is capable of providing a fog ceiling along the approach zone of at least 200 ft., and this for a distance of about 1,500 ft. before the commencement of the runway. In the actual runway area the fog ceiling may be lower, and a height of 50 ft. is sufficient at the far end of the track.

One of the main advantages of the new high-pressure FIDO system undoubtedly lies in an atomisation of the fuel by the burner heads, which permits the use of heavy petroleum fractions. Tests have revealed that, under these conditions, diesel oil can be burned just as efficiently, and with as little smoke as petrol. Low-grade, unleaded petrol can also be used in regions where it is cheap to obtain.

A complete commercial FIDO installation would have to comprise the following components : 1) fuel storage for at least 250,000 U. S. gallons to assure under emergency conditions a continuous operation for several hours ; 2) a low-pressure pumping system able to deliver fuel in large quantities at 90 lb./sq. in. ; 3) a multi-stage centrifugal pump for supplying the burners with fuel at pressures up to 1,500 lb./sq. in. ; 4) a high-pressure supply line network ; 5) atomising burner heads mounted on riser pipes ; 6) automatic igniter unit ; and 7) a remote control device for the pumps, supply lines, and igniters.

Fig. 1 shows the test installation at Arcata, where a total of 134 burners are distributed along the main runway. Two different burner nozzle systems, for producing one or three flames, are arranged together in groups. In the approach zone, beginning at a distance of about 1,200 ft. from the beginning of the runway, are altogether 19 triad burners on either side of the track, at 168 ft. from the axis and at 100 ft. apart. These two rows continue along the first half of the track with another 18 nozzles which this time are located further apart from each other, at distances of about 300 ft. These large burners are supplemented by six groups of single-nozzle burners, two (E, F) of which are situated before the beginning of the runway at 430 ft. from the axis, a third (D) at the same distance to the right of the track, and the three remaining ones (A, B, C) to the left of the second half of the runway at a distance of 720 ft. to the side.

The supply system to groups A, B and C may be seen from Fig. 2. The pump house (cf. Fig. 1) contains four independent low-pressure supply pumps, delivering fuel to a nine-stage centrifugal pump which in turn discharges it at a rate of 840 U. S. gallons a minute at an initial maximum pressure of 1,850 lb./sq. in. The drive comprises an 800-H. P. electric motor.

From the pump house the fuel is delivered through seamless welded supply pipes of 8 inches in diameter, capable of withstanding up to 2,000 lb./sq. in. The individual burner sections are served by 2 ½-inch pipes, to which are connected 3/4-inch riser pipes, bearing the burner nozzles and projecting from 6 to 12 inches above ground level, according to the contour of the terrain.

The single nozzle burners, arranged at Arcata in opposing pairs, and the triad burners are illustrated in Figs. 3 and 4. If the burners are located near enough to each other for the flames to touch, which usually happens in the

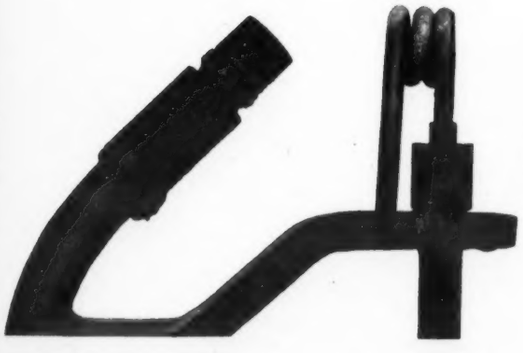


Fig. 3 : Single-nozzle burner with igniter wire.

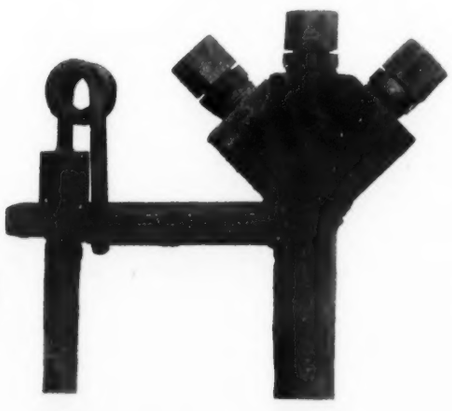


Fig. 4 : Ignition device for triad burner.

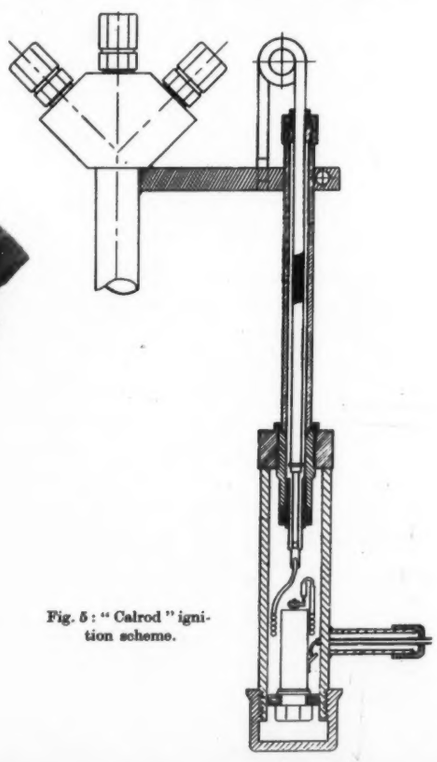


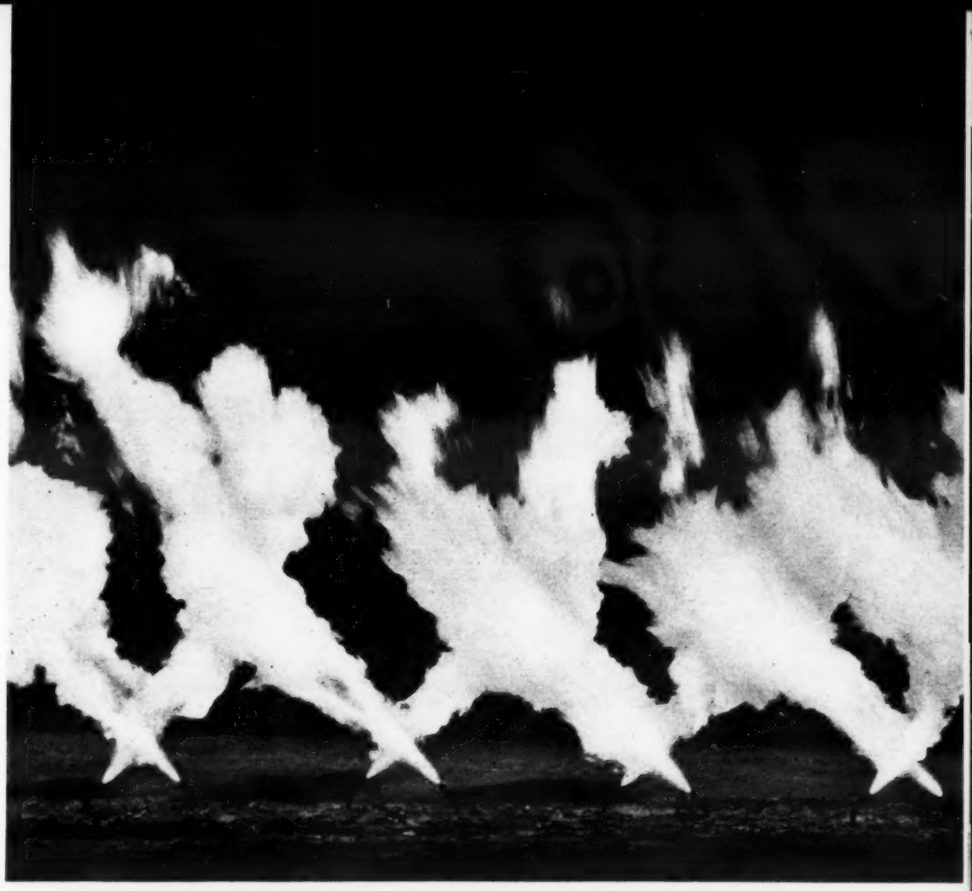
Fig. 5 : " Calrod " ignition scheme.

Fig. 6: Flame pattern of FIDO burners set crosswise.

case of a "cross-over" arrangement, igniters are not fitted to each individual burner, but only to every third or fourth group; this also applies to the triad burners. After extensive research the *General Electric Co.* developed a reliable electric igniter; the former practice was to light the burners with a naked flame. Known as the "Calrod," this igniter consists of three coilings installed in the vicinity of a fuel jet and, operating directly from 110 volts, produces a sheath temperature of about 1,750 deg. F.; the construction of the "Calrod" igniter is shown in Fig. 5. Figs. 6 and 7 are night photographs of a row of double burners, arranged crosswise, and the flame pattern of a triad burner.

Every item of airport equipment has to be ready for operation at all times. Great care was taken that, without further maintenance, FIDO should constantly be in working order; and this is readily apparent when one considers that the major portion of the system lies underground. The large supply line network has to be very carefully welded and cleaned; and in choosing a metal for the pipes, the presence of corrosive components of unrefined fuels must be taken into account. (Fig. 8.)

An idea of the fuel costs incurred by the Arcata FIDO system can be obtained from the following figures. By using the two single-nozzle burner groups D and E (each 200 yards long) together with all the triad burners (cf. Fig. 1) of 1,800 yards total length and a pump pressure of 1,800 lb./sq. in., the fuel cost per minute was estimated at $ 30.85. The liquid fuel used had a thermal output of 1.244 therms/gal. and cost $ 0.08 per gallon. At the above pump pressure a thermal output of 64 therms per yard was achieved for groups D and E, and 1.9 therms per yard for the more spaced-out triad burners. A further test with the pressure lowered to 1,700 lb./sq. in. resulted in an output of 54 therms per yard for groups D and E, and 1.7 therms per yard for the triad burners; the cost (with the same fuel) amounted to $ 28.93 per minute. It worked out even cheaper with diesel oil, which had an output of 1.373 therms/gal. and cost $ 0.07 a gallon: at a pump pressure of 1,650 lb./sq. in., the thermal output was 64 therms/yd. (groups D and E) and 2.0 therms/yd. (triad burners), whereas the operating cost amounted to $ 24.95 a minute.



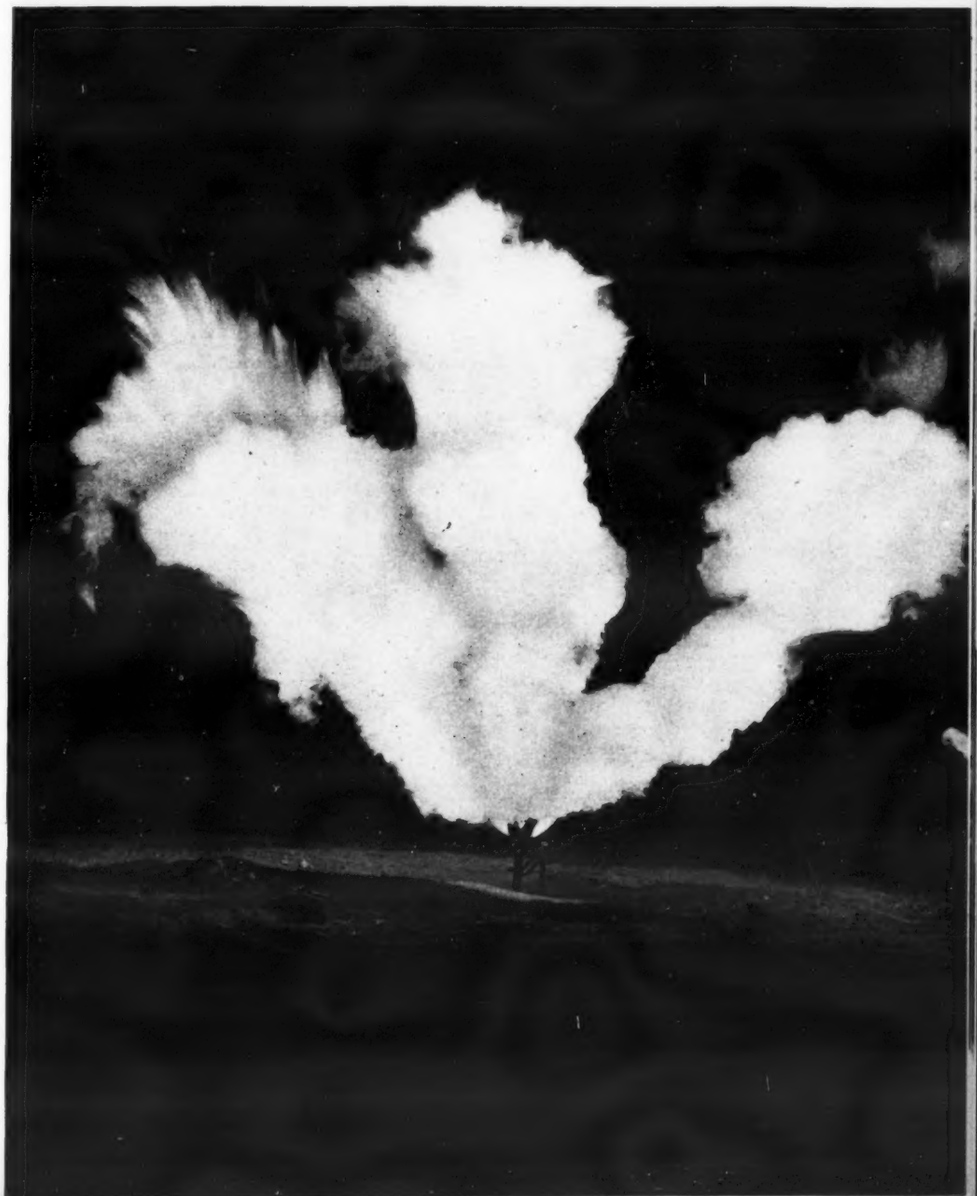


Fig. 7: FIDO triad burner.

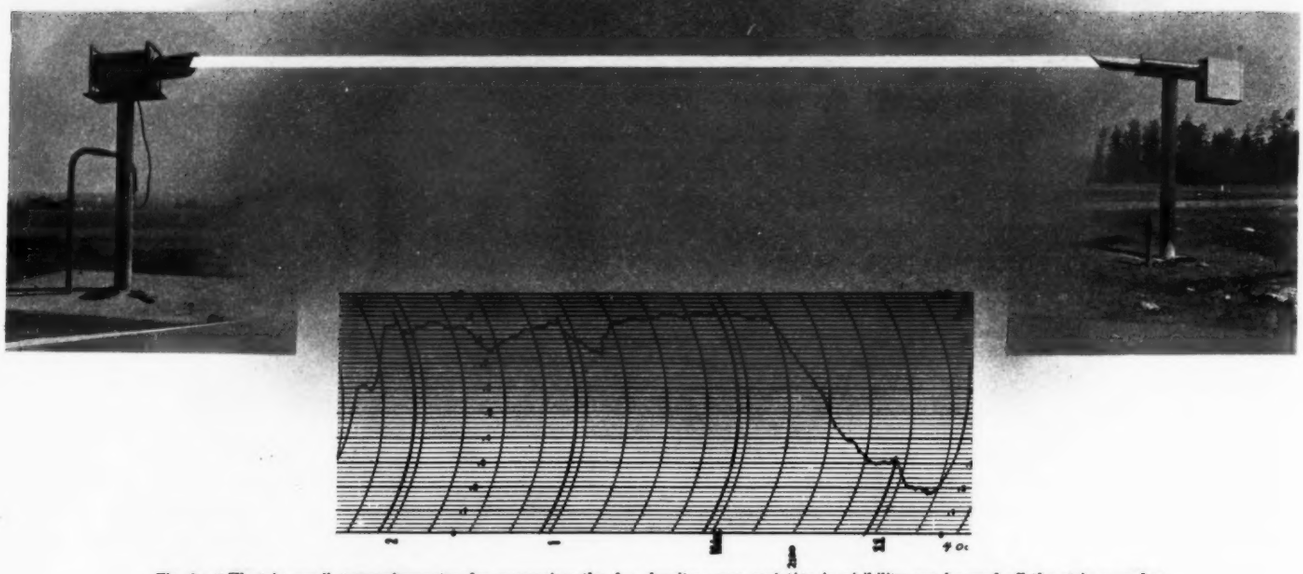


Fig. 9 : " Electric eye " transmissometer for measuring the fog density ; any variation in visibility can be read off the strip recorder.

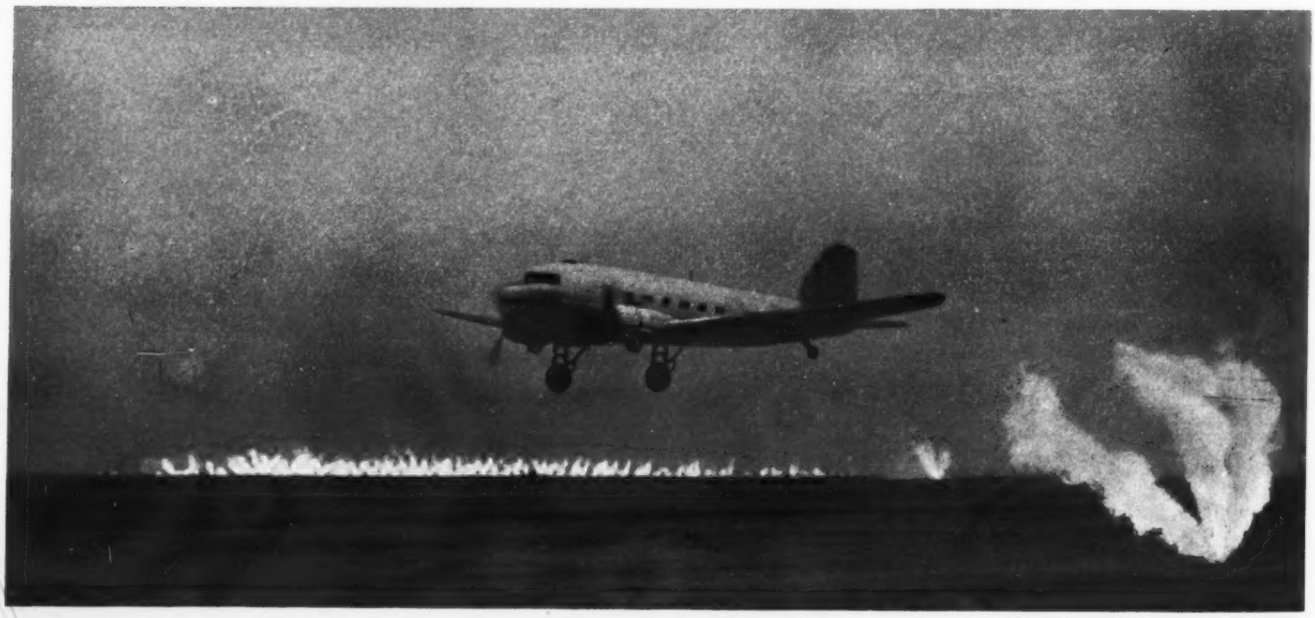
Fig. 8 : Supply lines with riser pipes and triad burners.

In order that the duration of combustion and choice of burner groups may be suited to the weather conditions, and to be able to control the efficiency of the system, "electric eye" transmissometers (Fig. 9), which constantly record the horizontal visibility, are mounted at various points of the landing area. Readings registered on strip recorders permit the fog density to be determined, and the fuel consumption can thus be set exactly to suit the weather conditions.

FIDO doubtlessly offers new possibilities to commercial aviation. However, it is not the only system at present being tested at Arcata ; and only its installation at a large airport, as it planned for Los Angeles, can show whether the costs are worth while. It is possible that other layouts may be conceived : whereas pilots will certainly get used to landing between rows of six-foot flames, the effect on the usually more sensitive passenger may not be completely disregarded.

At all events, airline companies and airport administrations can scarcely be expected to bear the costs of installing FIDO until state-financed experiments have thoroughly proved its reliability and commercial value for all-weather flying. *Bi.*

Fig. 10 : Landing on instruments at Arcata ; in front is a triad burner and to the rear, a row of crossed burners.



The Air Hostess Told Us ...

Airline Economics.

Our favourite air hostess is delighted that summer has come back. The longer flying hours are just one way the warm season helps airline economics along, inasmuch as airline regularity is much improved. In fact, Esmeralda says, when delays occur on her international runs, the cost of rooms and meals for a ship with forty passengers is enough to cut a sizeable slice out of profits. For instance, on the run from the Azores through Lisbon and Madrid, there is very apt to be an overnight delay at Lisbon in the winter season, because of C. A. A. regulations prohibiting American airliners from landing at Madrid at night. The flying time between the two stops is only an hour and a half, but if dusk approaches the aircraft must stay over until the next morning.

A few weeks ago, Esmeralda reports, her flight spent the night at Lisbon. Passengers and crew did not stay down town but drove the thirty miles to Estoril, the lovely seaside resort near the Portuguese capital. The Casino was a few blocks from the hotel, passengers and crew had a go at the tables and lost bags of money.

The airline paid all the bills, except the gambling debts and hard liquor. American passengers, who in the States drink milk or coffee with their meals, got a kick out of the fact that they were served wine for dinner, at the company's expense. The fun came at the end, however, when those who drank water were presented with a bill.

It's a wonderful country, Esmeralda sighs, where wine is free but one pays for water. She still hasn't figured out if it was all an error or not.

Aviation Spirits.

Spirits, Esmeralda says, have superseded food in last month's aviation news. There was the International Air Rally at Cannes from May 24th to 26th. The trophies were cases of champagne, wine and liqueurs. Then there was that announcement by Pan American Airways that it was introducing free "cocktails for two at 10,000 feet" on its San Francisco—Honolulu service. Passengers, however, will be limited to not more than four Scotch or Bourbon highballs each, probably because P. A. A. prefers its clients to become boisterous after they get to Hawaii and not before. Esmeralda understands that the liquor costs you nothing. On several lines you can have a wine list for the asking, only you pay for your drinks. TWA, on the other hand, offers a free shot of brandy to people who feel faint for one reason or another, and our favourite hostess says that as soon as they find out about this, some passengers feel faint for no reason whatever.

KLM Royal Dutch Airlines have recently decided to toe the liquor line. Always tradition-conscious, the company buys its supplies from the Bols distillery, one of the oldest Dutch firms in the field. Unless the powers that be object, you may now get serenely crocked on cherry, apricot or peach brandy, *Crème de Cacao* or *de Menthe, Triple Sec,* Curaçao, Dry Orange Curaçao or *Z. O. Genever*, and go out cold halfway between Amsterdam and New York or the Dutch East Indies.

Which goes to show that aviation stimulates a variety of trades. This time it is the turn of the liquor business, and with the imminent advent of bigger aircraft with built-in bars, we can easily imagine stockholders of the liquor firms rubbing their hands in anticipation of even higher dividends at the end of the year.

Flying in China.

In the course of her extensive travels, Esmeralda has come to the conclusion that the feelings which aviation provokes in people range from terror to resignation. Some African natives still consider the aeroplane as something supernatural. In America and Europe, the younger generations are enthusiastic about flying, whilst oldtimers have accepted it as another of these modern, yet indispensable nuisances. But nowhere, our favourite air hostess says, has aviation been accepted to such a point of utter boredom as in China.

On the other hand, aircraft engineering in three easy lessons might be taught to some of the Chinese crews. That such a course might be beneficial is shown by a recent accident in which a Douglas DC-3 on a regular flight in China shed a wing in mid-air. The accident investigators soon discovered that, in order to make a penny or two on the side, the crew had decided to smuggle a little gold from India to China or vice-versa. And to provide a suitable hiding-place, they cut out a chunk of wing spar at the root and calmly deposited their treasure in the resulting cavity . . .

Noah's Ark . . .

Modern airliners must not only be flying restaurants in daytime and flying hotels at night : recent reports seem to indicate that flying zoological gardens are becoming the fashion. In April TWA flew 88 snakes, 500 lizards and 17 rare African birds from Cairo to New York, and Purser Harlan Bishop had a busy time serving meat and water to his passengers. On May 15th, TWA had a unique passenger in the shape of Yusen Yu Toi, a Pekinese dog, who had been sold by a British breeder to Mrs. Quigley, of Lockhaven, Pa., for $5000.00 and was the "most valuable dog of its race ever to be flown to America." Unfortunately, the Peke was as dead as a doornail when he landed at New York, and at the time of writing Mrs. Quigley was awaiting an autopsy report to determine the cause of the death of her acquisition. And in the middle of April ten cats were flown by Air France from Lausanne to Paris—together with their owner, a wealthy American miss—to take part in a cat show.

But wait, says Esmeralda, that is only the beginning of the fun. The other day the New York Zoo bought three duck-billed platypuses, whose normal habitat is the rivers of Australia and Tasmania. The platypus, which is described as one of evolution's leftovers, is a delicate, primitive mammal that has rarely survived captivity ; moreover, its diet consists of about 800 earthworms a day.

Hence, the transport of the three animals presented certain problems, and the airlines were naturally asked to help. First, the platypuses were shipped from the Healesville Sanctuary, Victoria, to Melbourne. At Melbourne they were taken aboard an aircraft of Australian National Airways and flown 950 miles to Brisbane, accompanied by iced earthworms, as overheated worms apparently have a tendency to mildew.

In Brisbane they were taken aboard S. S. " Pioneer Glen, " destined for Boston, again accompanied by worms and Mr. David Fleay, director of the Sanctuary. As the boat was nearing the Panama Canal Zone, Mr. Fleay sent off a radio signal saying that his worms were giving out. The signal was relayed to the officials of the New York Zoo, who promptly dived under the Lion House where the earthworms are kept and dug up 10,000 of them. Duly iced, these were flown to Miami by Eastern Air Lines, from Miami to Balboa in the Panama Canal Zone by Pan American Airways. And to round off the picture, the earthworms were fed in flight on cornmeal, bread, sand and wet newspapers to prevent them from giving up their ghosts before being gobbled up by the platypuses . . .

All this to enable zoologists to be fascinated by platypuses without going to Australia. Our favourite air hostess makes one comment : she wants to know who counted those ten thousand worms, and how.

Tailpiece

In a jocular vein, Esmeralda suggested in May that helicopters should be used for catching flies. She was thrilled to hear, therefore, that Flight Lieutnant Ridgway, a pilot of RAF Coastal Command, is using a helicopter in an attempt to catch a small insect called Black Dolphin which is blown across the Channel in increasing numbers and is causing damage to English crops. Ridgway, who is stationed at Wartling Hill RAF Station, near Eastbourne, trails a circular net behind his helicopter to scoop up any insects encountered. So far no Black Dolphin has been caught, but the RAF is not giving up. Esmeralda says that a butterfly net and a pair of good legs might be equally effective.

P. A. B.

A " blimp " hangar at the U. S. Naval Air Station at Weeksville, North Carolina, filled with Helldivers, Corsairs, Hellcats and Seahawks awaiting shipment to long-term storage points.

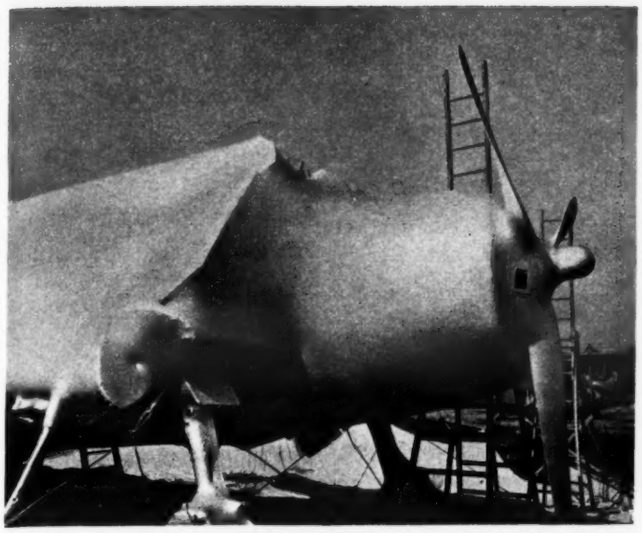
Canned and Pickled Aircraft

The U. S. Navy has launched a programme to "can" a large number of its surplus — but modern — carrier-borne aircraft for later use.

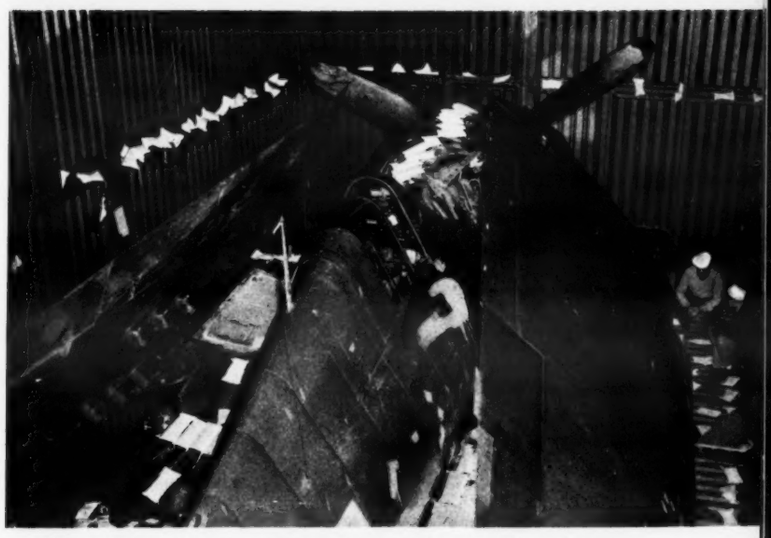
These aircraft will be employed in the next five years to fill the gaps occuring in the Navy's post-war operational air strength by peace-time attrition, such as accidents and normal wear and tear.

Under the programme, a total of 2,020 late-model carrier-borne Grumman F6F "Hellcat" and Vought F4V-5 "Corsair" fighters, Curtiss SC-2 "Seahawk" observation aircraft, Grumman TBF "Avenger" torpedo-bombers and Curtiss SB2C-5 "Helldiver" dive-bombers, valued at more than $ 150,000,000, will be preserved at six bases scattered throughout the country : 700 aircraft are to be stored at the Pensacola Naval Air Station, Florida, 400 each at Jacksonville, Fla., and at San Diego, Cal., 250 each at Norfolk, Va., and Alameda, Cal., and 20 at the Naval Air Material Center, Philadelphia, Pa.

Over a considerable period of time the U. S. Navy has been testing methods of protecting its aircraft against weather effects and corrosion, in order to maintain them in a "near fly-away condition." One method consists of "pickling" aeroplanes in a "cocoon" of weather-resistant plastics ; in this method the aircraft is enveloped in a web of tape, on to which the plastic material is sprayed. Subsequently plexiglass observation windows and airtight openings for the insertion of static dehydrating agents are installed. This process has not proved completely satisfactory, especially not in areas subjected to seasonal windstorms. As a result, the Navy has decided to store its smaller surplus aircraft in metal containers. Development work on the "cocoon" type of preservation is being continued, however, as the possible solution to



A Grumman "Hellcat" naval fighter preserved in a "Cocoon." The plexiglass window permits reading of the humity indicator. This method of preservation has been found more desirable for large aircraft; smaller types are now being "canned."



A "Hellcat" fighter in its "can." The small bags contain a desiccant which absorbs water vapour from the air. Another air-conditioning method consisting of a blower and automatically controlled dehumidification cycle was subsequently adopted.

the problem of storing larger types of aircraft, since metal containers cannot be procured in larger sizes at a reasonable cost.

The "canning" process adopted for the smaller types involves sealing the complete aircraft, with wings folded, in containers constructed from 10-foot panels of corrugated steel. The container housing a "Hellcat", "Corsair" or "Seahawk" is 40 ft. long, 19 ft. wide and 17 ½ ft. high, the one storing an "Avenger" of "Helldiver" has the same length and height but is 24 ft. wide. The advantages of the metal cells are chiefly that they permit the storage of aircraft overhaul centres in any climate and that they can be used more than once.

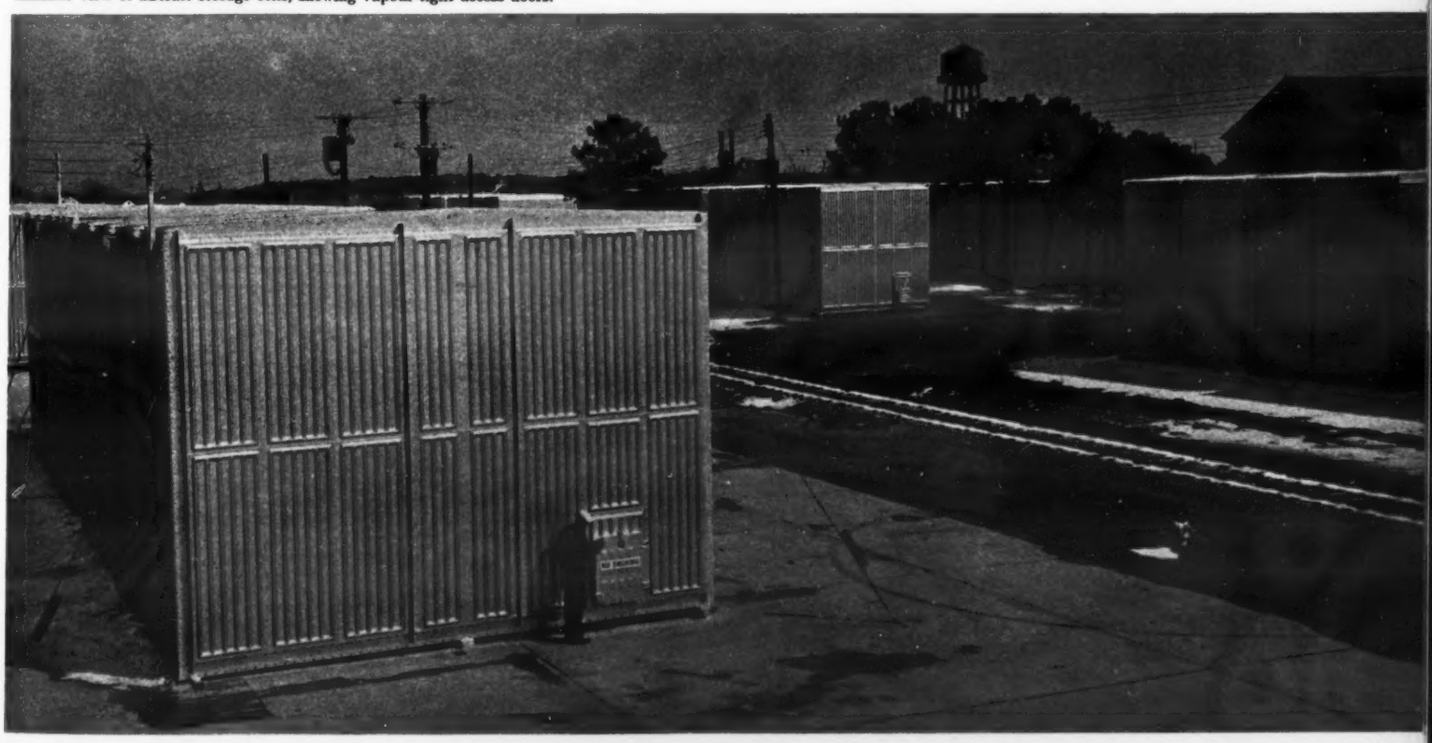
To provide optimum conditions for the preservation of aircraft, the "cans" are air-conditioned. Completely dry air produces a deterioration of rubber and other organic materials, whereas moist air causes corrosion of metals, especially aluminium. Laboratory tests have shown that clean air of about 30 percent relative humidity is most suitable for aircraft storage. Two procedures ensuring maintenance of this degree of humidity were tested by the U. S. Navy. In the first, static desiccants were used. In the second, the internal air was circulated by blowers through an automatically regulated dehumidification cycle. The latter method provided more positive control and was adopted.

In order to make possible rapid checks, glass windows are fitted to the steel "cans," allowing easy reading of five instruments which record interior temperature and relative humidity in different portions of the container. In addition, vapour-tight access doors are provided in the cell to permit entry for more thorough inspection.

Half of the more than 4,000 aircraft now in interim storage at American naval air bases will shortly be absorbed as replacements for aircraft in service. The "canning" and preservation of the other half will save the American taxpayer a tidy sum of money.

P. A. B.

Exterior view of aircraft storage cells, showing vapour-tight access doors.



"Thunderjet"

The world air speed record has been held by Great Britain since November 7th, 1945, when *Group Captain H. J. Wilson* achieved 606.262 m. p. h. in a Gloster "Meteor IV" twin-jet fighter.

The prestige of national aircraft industries has always been linked with world speed records. In 1945, when the F. A. I. homologated Wilson's flights, nobody thought that this achievement would remain unbeaten for even six months. Notably the American aircraft industry overstepped the mark in its announcements of new experimental supersonic aeroplanes; and in a closely guarded hangar at the Burbank plant of the Lockheed Aircraft Corporation certain initiated people were allowed already in the spring of 1946 to admire a special version of the fastest American jet plane of that time, the Lockheed P-80 "Shooting Star." In compliance with all rules of the game, this plane was being prepared for an official attack on the speed record.

Meanwhile, for "technical reasons" official U.S. record attempts were repeatedly postpon-

A P-84 leaves the hangar.

ed ; and after September 27th, 1946, when Geoffrey de Havilland crashed in his D. H. 108 "Swallow" jet aircraft through causes still not entirely clarified, U. S. announcements of forthcoming attempts began to sound less confident.

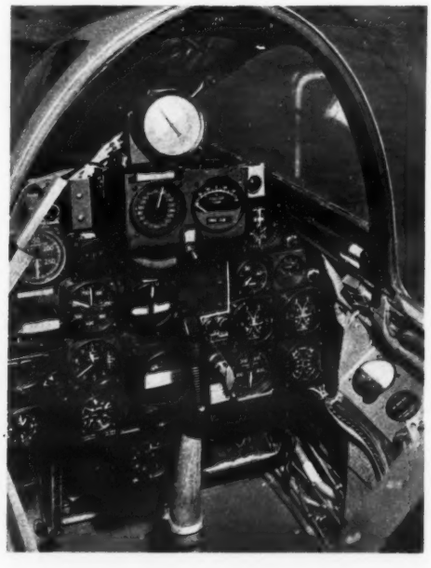
In the meantime the U. S. aircraft industry, this time represented by an East Coast firm, has nominated a new contender for the title of "the world's fastest aeroplane" : on May 9th, 1947, *Republic Aviation Corporation,* of Farmingdale, L. I., announced that the U. S. Army Air Forces was preparing for an *attack on the world speed record* with the new *Republic P-84 "Thunderjet"* jet-propelled fighter.

The "Thunderjet," which in very name so aptly describes the hitherto never correctly defined noise made by high-performance jet planes, may eventually find its place in the annals of aeronautical history within the next few weeks. America can already lay claim to an F. A. I. controlled speed flight in which the P-84 attained an average of 611 m. p. h., thus only 5 m. p. h. behind the later British record of 616 m. p. h. established on September 7th, 1946, by Group Captain E. M. Donaldson. What is not widely known is that, already at that period, America was near to running off with the speed record : the "Thunderjet" speed flights took place on the same day as Donaldson achieved his successful result in England.

At the Republic plant some 8,000 are employed on the serial production of the P-84 "Thunderjet" ; and the U. S. A. A. F. has placed orders for over 500 units. The power

Carl A. Bellinger, equipped with parachute, crash-helmet, oxygen mask and the most important item, the knee-pad, climbs into his plane.

For the test flights, the cockpit of the Republic " Thunderjet " is fitted with three special indicators in place of the gun sight.



A black smoke cloud can be seen behind the P-84 when it flies at top speed near to the ground.

plant is the most powerful gas turbine engine available in the U. S. A., the TG-180 pure jet engine developed by General Electric Co. It is an axial-flow turbine, concerning which no data have yet been released. Instead of the lateral intakes peculiar to most American jet planes, the installation in the "Thunderjet" incorporates an air intake which lies in the axis of the aircraft and has its opening in the fuselage nose. The P-84 is a mid-wing monoplane with tricycle undercarriage; it has a slender fuselage which houses the jet engine in the centre section. The cross-section of the jet outlet area at the rear can be varied during flight, enabling the thrust to be set in accordance with speed and altitude. For the metal wing, of which the spars are in front of the engine, a laminar-flow airfoil has been chosen, which is the same as the one developed by Republic for their "Rainbow" high-altitude airliner. This airfoil, which differs from the NACA laminar-flow airfoil mainly in the vicinity of the trailing edge, has its maximum thickness at a point between 40 and 45 per cent of the chord.

Both the wing and tail plane feature an upward dihedral of 5 deg. The undercarriage is proportionately high, presumably in order to eliminate undesirable ground influence on the jet stream, which occurs during take-offs and landings. As in the case of other high-performance aircraft, special high-pressure tyres have had to be developed in view of the thinness of the wing roots. It will be readily apparent that particular care has been taken to produce a refined exterior form: apart from the sliding plastics canopy, the fuselage features no protuberances of any kind, and the radio equipment with its antennae is also housed inside the fuselage.

As the "Thunderjet" is one of the U. S.

A mechanic has to stand by with a ladder, as the cockpit is set very high and, so as not to spoil the exterior refinement, the fuselage has no foot-holes.

The "Thunderjet" lands on the main wheels only; the smoke cloud behind the plane is caused by the tyres during the first contact with the runway.

Before climbing out Bellinger discusses his knee-pad jottings with one of the designers and a U.S.A.A.F. officer.

Army's very latest fighters, it is normal that only a few details have been released ; it is not possible to publish more than the following data on the main dimensions :

Span	36 ft. 5 in.
Length	37 ft. 2 3/8 in.
Height	12 ft. 10 1/4 in.
Wing chord at root	9 ft. 2 1/4 in.
Wing chord at tip	5 ft. 3 in.
Tailplane span	13 ft. 11 5/16 in.
Max. tailplane chord	5 ft.

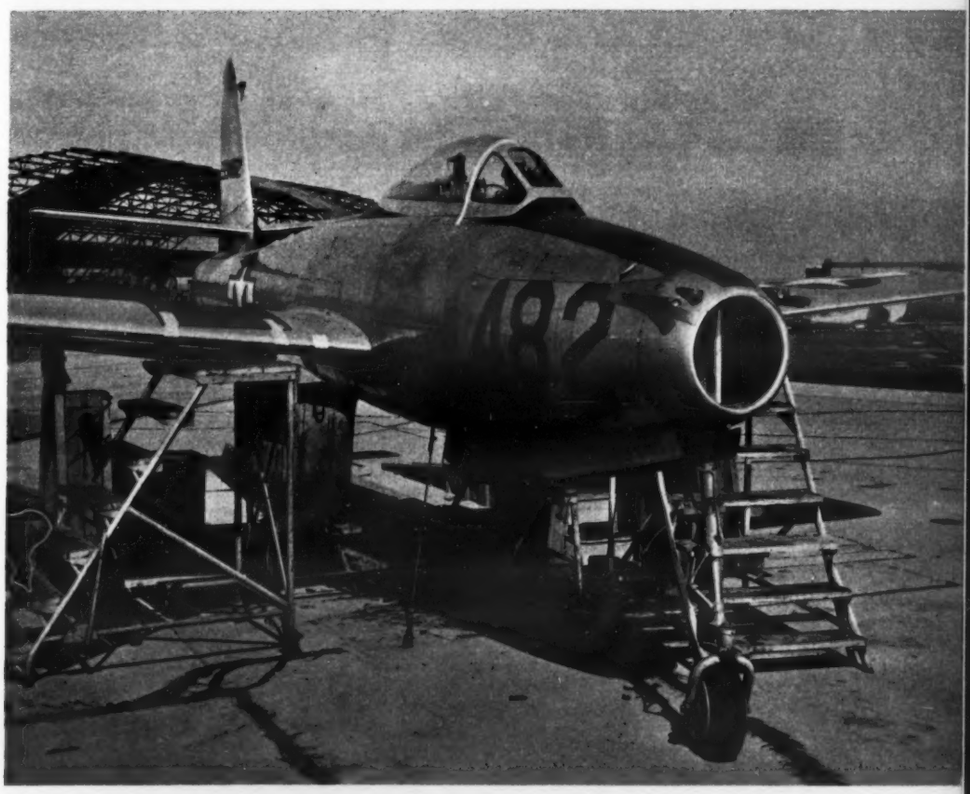
Like in the Lockheed P-80 "Shooting Star," auxiliary fuel tanks can be fixed to the wing tips so as to give the "Thunderjet" a range of more than 1,000 miles ; service ceiling is reported to be 40,000 ft.

The main armament is fitted in the nose above the air intake. To all appearances it consists of four 20-mm. automatic cannon ; two fixed guns are built into the wing roots.

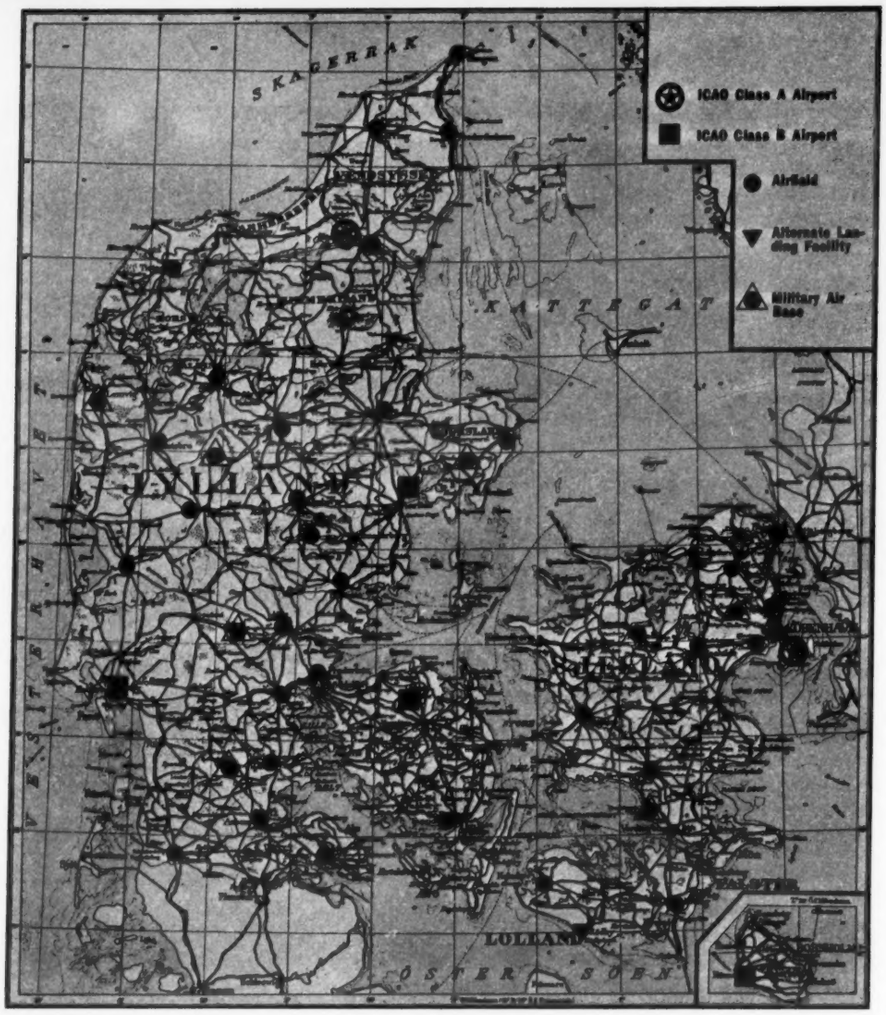
It is interesting to learn that by this summer the first U. S. A. A. F. units will have been equipped with aircraft capable of competing for the world speed record. A number of selected pilots of the 14th Fighter Group are already being initiated in the handling of the P-84 by Republic's test pilots. It would not appear to be a simple matter, as all the pilots selected for this course have to possess experience of the P-80.

The accompanying photos portray an episode during the testing of the "Thunderjet," which is being conducted by Carl A. Bellinger, the firm's chief test pilot. Flying a jet plane is not without danger ; and the U. S. A. A. F. insists that jet pilots always wear crash-helmets as a protection against eventual injuries through sudden jolts of the plane. The top speed of the P-84 is only very little below the zone referred to as the sonic barrier, a zone where brusque alterations of the wing and tailplane flow can occur, producing extremely sudden losses of stability.

Nearly 23 years ago, on December 11th 1924, America lost her world speed record to France, and has never succeeded in regaining it since. At that time it amounted to 278.5 m. p. h. ; it has since more than doubled itself. In his forthcoming attempt, the pilot of the Republic P-84 "Thunderjet" will be confronted by no easy task. *Bi.*



The P-84's fuselage guns are carefully tried out ; in the above aircraft flame dampers are being tested, which are not fitted in the standard version.



General Map of Danish Airfields and Danish Ground Organisation. (1 : 1,500,000.)

From War to Peace

Luftwaffe Bases Become Danish Airports

BY C. WERNER FREDERIKSEN, COPENHAGEN

Just as the Danebrog, the Danish State flag with a white cross on a red field, fell, according to legend, from heaven to signal the Danish victory at Lyndanis, well-equipped airfields fell into the hands of Danish aviation after the Second World War. Danish service and commercial aviation took possession of their heritage from the Luftwaffe.

During their five years' occupation of Denmark, the Germans erected numerous military installations throughout the land. Most of the air bases were on the Jutland peninsula. As the contractors had not to pay for these constructions themselves, no expense was spared and enormous sums were invested. Entire villages disappeared. Gigantic agricultural areas were divested of their original purpose.

One of the first areas to fall to the invader's pick and shovel was Aalborg, in North Jutland, but soon afterwards air bases were erected at Karup (Central Jutland), Esbjerg, Vejle and Hadersleve (South Jutland), and Tirstrup, in the eastern part of the peninsula. Further north, Beldringe Airport was built near Odense, on the island of Fünen, whereas no constructions of any particular importance were erected on Seeland. Kastrup Airport, serving Copenhagen, which was already in operation before the war, did not seem to interest the German authorities very much, as they only used it as a blind-flying school. A number of hangars were erected, but these did not come up to the standard of the constructions on the Jutland air bases.

Meanwhile, it cannot be said that the Danes acquired these airfields entirely without initiative on their part. On the contrary, they began to take possession of their inheritance during the heat of battle and under the very nose of a vigilant invader. The war was only in its initial stage when Danish aviation began to shape the plans which today allow it to participate successfully in international aviation. As regards flying equipment, the energetic president of DDL, Per Kampmann, negotiated delivery contracts with American aircraft manufacturers during the war. Preparations for the future ground organisation began at roughly the same time. On October 16th, 1943, the Danish Ministry established a committee which was to draw up plans for a new ground organisation and project airports, of size and number sufficient to fulfil the requirements of future peace-time flying. This committee submitted its final report on December 12th, 1945, which served as a basis for the Law on public airports, passed on July 12th, 1946. The Ministry of Public Works was authorised to take over and operate, on State costs, the airfields at Aalborg, Esbjerg, Odense and Rönne (Bornholm). The accompanying map provides a general survey of Danish ground facilities, planned and in existence. It is derived from the official report and shows both small and large airfields.

Aalborg Airport.

It may sound paradoxical to say it was advantageous that the Germans took possession of Aalborg Airport as soon as they began their occupation of the country. But this is a fact, for, during the first few months under the enemy, the Danish labourers had not had time to learn the various methods of sabotaging their work; by using inferior materials, and many other tricks. If the Germans had begun their work at Aalborg during a later stage of the war, Danish civil aviation would have acquired runways of which the cement surface was ruined through sugar having been mixed with it.

Meanwhile, however, Aalborg, Denmark's third largest city with about 81,000 inhabitants, was provided

One of the numerous German fortifications with walls of several feet in thickness. These are costly nuisances to remove.

Aalborg administration building, opened on May 21st, 1947.

with a perfect airport. Before the war there was only a small airfield of some 300 acres at Limfjord, about three miles from the town, which began operating early in 1938. A smooth, resilient grass surface served the office of runway.

Today, the airport covers an area of 3,250 acres, on which there are no less than 33 large and medium-sized hangars, in addition to a whole number of workshops, living and administrative quarters. The main landing strip is 5,500 feet long and 2,800 feet wide. Two of the hard-surface runways measure 5,500 feet, a third 4,200 feet, and all are 250 feet wide throughout their entire lengths.

The Danish Authorities are all the same not completely satisfied with the installation as it stands, and intend to continue developing it. The financial committee of the *Landsting* granted Kr. 290,000 for a new lighting system, and there is a plan for lengthening the runways to 7,800 feet, in order that the airport may satisfy ICAO Class A requirements. Of course, Kastrup-Copenhagen will remain Denmark's chief airport, as hitherto. But Aalborg is to be developed so that it can assume a position among the main European airports and serve as an alternate landing facility for trans-Atlantic services.

The removal of old German fortifications and other military installations is still causing considerable trouble and costs. Including the means for a new administration building, it is estimated that this work will require Kr. 400,000, towards which only Kr. 100,000 has so far been authorised. The final expansion of the airport will cost around two and one quarter million kronen.

In view of the difficulty in obtaining building materials, the administrative headquarters have temporarily been housed in what was formerly the German Kommandatur H. Q., so as to avoid any undue delay in operations.

The most difficult problem in developing airports is usually the expansion of the site, which necessarily entails buying up land and expropriating tenants; and this often incurs righteous protests from the owners. The greater part of the 3,250 acres used by the Germans, bore wholly military installations which were void of any value to commercial aviation. The site taken over by the Danish State covers less than 2,000 acres. The superfluous land is shortly to be given back to its former owners, provided they wish to regain possession of it. Otherwise it will be sold to any interested third party.

It may be of interest to note a few details on operations at Aalborg Airport. Twice-daily connections with Copenhagen are maintained by DDL; once-daily with Oslo, also by DDL; thrice-weekly services linking Oslo via Kristiansand—Stavanger, provided by DNL, the Norwegian carrier; and similar connections with Gothenburg (Göteborg), by DDL. As already mentioned, Aalborg simultaneously serves as an alternate trans-Atlantic airport.

Esbjerg and Odense.

As regards importance, the installations at Esbjerg and Odense lie far behind Aalborg. Esbjerg, a town of some 44,000 inhabitants, possessed a small airfield before the war. It was opened to public use in the summer of 1937, and scheduled services to Copenhagen, Aalborg and Hamburg were in operation a year later. The German occupational authorities expropriated the tenants and expanded the area from 120 to over 850 acres. However, they did not consider it necessary to lay down hard-surface runways, and were content to land on a grass area of 5,500 feet in length and 2,800 feet in width.

Aalborg Airport. Left, in white circle: the new terminal building.

On the basis of the law passed in 1946, Esbjerg is at present being developed for scheduled domestic services. Initially, runways of up to 4,200 feet are being provided, which will have neither concrete nor any other type of hard surfaces.

Odense, the capital of Fünen, has about 105,000 inhabitants and is the second largest city in Denmark. Contrary to Aalborg and Esbjerg, it had no airfield before the war.

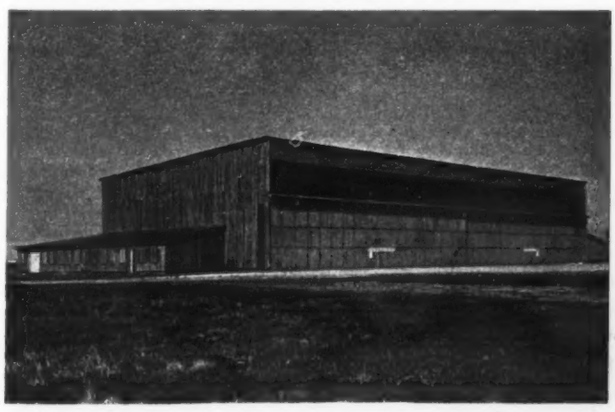
The Germans constructed a very large airfield in the vicinity of the village of Beldringe, about five to six miles northwest of Odense. For this purpose, people were expropriated over an area of 4,000 acres. Fortunately, a good number of the villages were only evacuated, not destroyed, so that the people have since been able to return to their homes. A concrete runway of about 6,000 feet in length was laid down in about the centre of the site. It is nearly 200 feet wide and fitted with electric flood-lighting.

At present there are no scheduled services being operated from Beldringe Airport, though it was pretty active last winter, when improvised services were flown to relieve shipping over the frozen Great Belt. Great numbers of passengers as well as large quantities of mail and freight were transported by air between Copenhagen and Odense, thus maintaining connections between the capital and the western regions of the country and the Continent.

* * *

The remaining air bases erected by the Germans have partly been taken over by the Danish Army. But there are still a certain number for which no decision has yet been formed. However, none of them, except perhaps Aarhus-Tirstrup, is likely to be of any particular use to civil aviation.

A German hangar which today provides ample space for large airliners.



One of DNL's Douglas DC-3's stationed in front of the Aalborg administration building.

Book Review

L'Abordage Aérien. — By Gérard Bolla. Published by Flückiger & Co., Lausanne, 1947.

What applies to a collision between two automobiles does not apply to a collision between two aeroplanes. All the same, the fear expressed by the author that his study might to a certain extent be too academic, is not justified. The fact that during the winter period between 1946 and 1947 several aeroplanes crashed in mid air over American and other airports, and even on established air lanes, sufficiently warrants a legal examination of the question.

The work is in the form of a 176-page pamphlet, and contains a well-conceived legal study of the liability of the aircraft owner. A small portion is devoted to Swiss law, but the large section on international agreements and the work of CITEJA makes the pamphlet of international interest. (French.) *He.*

Beitrag zur Kostenlehre des Luftverkehrsbetriebes. — By Dr. Th. Stauffer. Published by Aeroverlag, Zurich.

The question of operational costs in commercial aviation, and that of its economic value, are at present of vital interest everywhere. Particularly in America—one of the few countries in which commercial flying is conducted entirely on a basis of private enterprise—operators and theoreticians are devoting themselves more and more to this problem, which forms the basis for economic operation of air services. The author gives a very clear description of the methods for calculating these costs ; and the value of the book is enhanced in so far as he has not confined this description to mere theory, but has included extensive practical tables. (German.) *He.*

International Air Transport, 1947. — Todd Reference Books Ltd., London and New York.

This is the third edition, now devoted to international air transport, of "Air Transport and Civil Aviation," a manual formerly restricted to British civil aviation. However, there is no great change in its general aspect, as it still remains a reference book chiefly for British airline operators, though the new edition does give a general survey of international commercial flying. An account on the international air organisations is followed by details concerning the various national authorities, airline companies, airports, etc. There is an introduction by the advisory editor, the Rt. Hon. Lord Semphill, A. F. C. (English.) *He.*

Aérodynamique. — By R. Pouit. Published by Dunod, Paris, 1947.

The author's intention is to familiarise the general engineer with the theory of aerodynamics. Commencing with the elementary principles, Pouit gives a survey of the laws of aerodynamics, though perhaps a little too condensed in form, and without the completeness which an expert might desire. The mathematical-theoretical handling of the problems is supplemented by a short chapter containing a number of graphs and practical formulae. Of particular interest are the chapters on rotary wing constructions, compressibility phenomena, and thermal problems in connection with gas turbines. Pouit's book will also be appreciated by practical aeronautical engineers. (French.)

Bi.

Carènes et Propulsion de la Galère à l'Hydravion. — By Robert Duhamel. Dunod, Paris, 1946.

This book is addressed primarily to shipbuilders, and is worthy of study in view of the thorough manner in which constructional problems are dealt with, and the great number of numerical tables it contains. Instead of giving long theoretical derivations, the author includes data of particular value to constructors.

It begins by describing the design and construction of hulls, whereby a small glossary of the most frequently used nautical terms is extremely valuable. Subsequently, a few theoretical considerations, but a multitude of practical pointers, deal with the design of aircraft floats and flying-boat hulls.

Finally, Duhamel discusses questions concerning the propulsion of seaplanes, and draws comparisons between ships' propellers and airscrews. (French.)

Bi.

Official Bulletin of the F.A.I.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE, PARIS.

Customs Carnets.

The Customs Authorities of certain countries seem to be definitely opposed to the adoption of the new Customs Carnet drafted by the Commission Internationale de Tourisme Aérien (CITA). These Authorities would prefer that the currently used model be retained, though they would agree to certain modifications.

It would be appreciated if the national Aéro Clubs would lose no time in establishing contact with their respective Customs Authorities, in order that the CITA may take a definite decision in this respect at its next conference.

Revision of the "Code Sportif."

As planned, the Committee of five which was given the task of revising the club flying regulations, has already submitted certain indications, so that preliminary work in this respect can be effected ; this work is being carried out by the F. A. I. National Aero Clubs are requested to send in any observations regarding the "Code Sportif" as soon as possible to the Secretariat, in order that the editors may take note of the new text and that the Commission de l'Aviation Sportive Internationale (CASI) may draft the final version in time for its next meeting.

Ambulance Air Services Congress.

The Aéro-Club de France has informed the F. A. I. of its intention to organise an International Congress on Ambulance Air Services in 1948.

Member Aero Clubs are asked to inform the Secretary General of the F. A. I. whether they would like to participate in this event and to send representatives to the meetings of the Congress.

Records Homologated by the F.A.I.

Class G — Helicopters.

Altitude (U. S. A.).

Major E. M. Cassell, U. S. Army Air Forces,
Sikorsky R-54,
Pratt & Whitney 935-AN-5 of 450 H. P.
Patterson Field, Dayton, Ohio, on February 10th, 1947—5,842 metres.

THE MONTH IN REVIEW

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POLITICAL

● The *Spanish Government* has authorised *Svensk Interkontinental Lufttrafik A. B.*, the Swedish overseas airline, to fly over Spanish territory and to make technical landings on the *Barcelona—Madrid—Portugal* service. Similar authorisation will also be given to DDL, the Danish airline, and DNL, the Norwegian airline, the other members of SAS, the Scandinavian joint airline.

● *Civil Aviation Agreements* have been concluded between : *U. S. A. and Argentina*, on May 1st in Buenos Aires ; *Canada and Portugal*, on May 4th in Ottawa ; *France and Greece*, on May 5th in Athens ; *U. S. A. and Chile*, on May 10th in Santiago ; *Czechoslovakia and Denmark*, on May 14th in Copenhagen ; *U. S. A. and South Africa*, on May 19th in Cape Town. — After three months of discussions, civil aviation negotiations in Nanking between China and Great Britain were broken off without final agreement being reached.

NEW AIRCRAFT

● The *first flight* of the SNCA du Nord's new *Nord 2100* twin-engined all-metal commercial transport took place on April 30th at Mureaux airfield. The aircraft was piloted by Mr. Détré, and Mr. Plissavy, the Chairman of the concern, accompanied him

Nord 2100.

● The first prototype of the *"Wheelair 111-A"* a four-seater personal aircraft developed by *Puget Pacific Planes, Inc.*, of Tacoma, Wash., and designed by the firm's Engineering Vice-President, Donald G. Wheeler, undertook its *first flight* on April 23rd.

Puget " Wheelair 111-A. "

● *Kaman Aircraft Corp.*, of Windsor Locks, Conn., which was founded some two years ago, has developed a three-seater helicopter, the *Kaman 125-A*, the prototype of which has been undergoing flight tests since January 15th. It has two inter-meshing contra-rotating rotors located above the fuselage centre, and a fixed tricycle undercarriage ; the empennage comprises moveable elevators and fixed end-plate fins. The helicopter is reported to attain high speeds, considerable altitudes, and an extensive range.

● *Vickers Armstrong Ltd.*, of Weybridge, Surrey, has a *six-jet bomber* under construction ; it is expected to be ready for test flights in 1951.

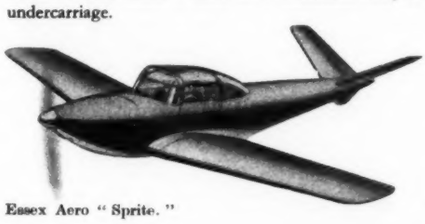
● The *Macchi M.B. 312* is a twin-engined trainer, the prototype of which was recently completed by *Aeronautica Macchi S.A.* of Varese, Italy. Powered with two Isotta Fraschini "Delta RC 40" air-cooled 12-cylinder V-type in-line engines of 800 C.V. for take-off, it reaches a maximum speed of 245 m.p.h. at 14, 760 ft. and a cruising speed of 210 m.p.h. ; range is 1,090 miles.

Percival " Merganser " feeder transport.

● *The first flight* of the *Percival "Merganser,"* a twin-engined feeder transport developed by Percival Aircraft Ltd., of Luton, Beds., England, took place on May 16th.

● The *de Havilland Aircraft Pty., Ltd.*, of Sydney, the Australian subsidiary of The de Havilland Co., of England, and originally merely the Australian commercial representation of the English firm, has almost completed the prototype of a *three-engined feeder transport*. It will accommodate six to eight passengers and is being powered with three "Gipsy Major 10" air-cooled four-cylinder in-line engines of 145 H.P each.

● *Essex Aero, Ltd.*, of Gravesend, Kent, is developing the *Essex Aero "Sprite,"* a new two-seater personal aircraft built entirely of magnesium. It is powered with a 100-H.P. engine built by the Nuffield Group. Span : 30 ft. 0 in. ; length, 24 ft. 7 in. ; height, 7 ft. 10 in. The tare weight of 921 lbs. of the "Sprite" is unusually low ; the gross weight is 1,590 lbs. The type is to be available with either a fixed or a retractable tricycle undercarriage.



Essex Aero " Sprite. "

● The *Grumman F9F* jet-propelled fighter developed by Grumman Aircraft Engineering Corp. for the U. S. Navy is apparently to be built in three versions : two fitted with a *Rolls-Royce "Nene"* jet-engine, and a third equipped with a more powerful version of the *General Electric G-33* (I-40) jet engine.

● Miles Aircraft Ltd., of Reading, Berks., has completed a second prototype of the *Miles M. 60 "Marathon"* four-engined short-range transport. It differs from the first version merely in the substitution of a conventional twin fin and rudder unit for the original triple fin and rudder unit. The "Marathon" is also to be produced in another version powered with two Armstrong-Siddeley "Mamba" propeller-turbine units

Second prototype of the Miles M. 60 " Marathon. "

each developing 1,000 H.P., instead of four air-cooled de Havilland "Gipsy Queen 71" air-cooled in-line engines of 330 H.P. This aircraft is to be designated Miles M. 69 "Marathon."

INDUSTRY

● Testifying before the House of Representatives' Committee on Interstate and Foreign Commerce, on April 28th, Phillip B. Taylor, one-time Vice-President and General Manager of the Wright Aeronautical Corporation, stated that construction of the *Republic "Rainbow"* four-engined high-speed transport (cf. "Interavia Review," No. 7, 1946) has been *suspended*.

● Some sixty representatives of the United States aircraft industry, Army and Navy, participated in a conference at Philadelphia on May 8th and 9th to discuss a standardisation and simplification of aircraft parts.

INDUSTRIAL PERSONALITIES

● Following the resignation on May 5th of LaMotte T. Cohu, Chairman and General Manager of *Northrop Aircraft, Inc.*, to become President of Transcontinental & Western Air, Inc., *Claude N. Monson*, Vice-President, was appointed as Northrop's *General Manager ; Richard W. Miller*, Vice-Chairman, was appointed *Chairman. Gage H. Irving*, Director and Vice-President in charge of Production, has been appointed *President and General Manager* of Northrop's motor-scooter manufacturing subsidiary, *Salsbury Motors, Inc.*, of Pomona, Calif.

INTERNATIONAL ORGANISATIONS

● IATA : The *Executive Committee* finished its meeting in Montreal on May 3rd. It will recommend the General Meeting, which is to take place in Rio de Janeiro next October, to authorise *the admission of non-scheduled international air carriers to IATA.*

AIR TRANSPORTATION

● NORTH ATLANTIC : On June 1st *American Overseas Airlines* will intensify its trans-Atlantic services from 19 to 24 round trips weeckly ; four of these new flights are to London and the fifth to Stockholm. On the same date AOA will reshuffle its five New York—Stockholm services, routing two via Iceland and Copenhagen and one each via Iceland and Oslo, Shannon—Prestwick—Oslo, and Boston— Shannon—Prestwick—Copenhagen ; all flights have intermediate landings at Gander. *British Overseas Airways Corp.* will introduce a sixth London—New York round trip on June 14th. According to a statement in New York by Viscount Knollys, retiring Chairman of BOAC, the Boeing "Stratocruisers," which the airline will put in service next year, will be fitted with first and second-class accommodation. — *Air France* has leased a 30-storey office and show-room building at 638, Fifth Avenue, New York, which will also serve as the airline's City terminal. — In order to use the short time remaining before the introduction of a ban on the import of luxury goods to Sweden, *Scandinavian Airlines System*, the Scandinavian joint airline, has hired a number of Douglas C-54's to carry out a trans-Atlantic freight service.

● SOUTH ATLANTIC : *Scandinavian Airlines System* has come to an agreement with *Lineo Aero Nacional*, the Chilean carrier, whereby LAN will transport

* Abridged extracts from Nos. 1305 - 1312 (May 8th to 24th, 1947) of "INTERAVIA, International Correspondence on Aviation," an illustrated newsletter published three times weekly in four separate language editions, English, French, Spanish and German.

passengers between Buenos Aires and Santiago in connection with the SAS service. — *British South American Airways Corp.* intends to inaugurate a London—Bermuda—Nassau (Bahamas)—Mexico service in July, to be operated with Avro "Tudor IV" airliners.

● NEAR EAST : *British European Airways Corp.* intensified its London—Marseilles—Rome—Athens —Istanbul—Ankara service from one to two round trips weekly on May 22nd, coincident with the replacement of Douglas "Dakotas" with Vickers V.C.1 "Vikings" on the route. — *Air France* has intensified its Paris—Beyruth—Teheran and Ankara services from two round flights monthly to one weeckly ; the service is routed via Rome and Athens instead of Tunis—Tripoli—Cairo.

● FAR EAST : On June 3rd *Pan American World Airways* will open a weeckly San Francisco—Hawaii—Midway—Wake—Guam—Shangai service ; by eliminating night stops, the journey will take only 50 hours. — *Pacific Overseas Airlines Siam, Ltd.*, a Siamese airline, has been founded in Bangkok, with 26 per cent of its capital held by the Siamese Government, 25 per cent by Siamese private interests and 44 per cent by United States interests ; it is associated with *Pacific Overseas Airlines, Inc.*, an American non-scheduled airline of Ontario, Calif., with which it has concluded a ten-year contract to open a weekly Bangkok—Shanghai —Hong-Kong—Manila—Guam—Wake—Honolulu—Ontario service. Siamese Government is endeavouring to make *Bangkok* the *airline centre of the Far East.* — *British Overseas Airways Corp.* is to open a new Hong-Kong—Manila—Borneo (or Sarawak)—Singapore—Bangkok—Hanoi—Hong-Kong service, to be known as the "South China Sea Circular Route." — Tasman Empire Airways has recently had to charter the services of Australian National Airways for inter-schedule trips with Douglas DC-4's to relieve the backlog of bookings for its Sydney—Oakland flying-boat service which is operated with six round flights weekly. — The assimilation of all domestic private New Zealand airline companies into the Government-owned *New Zealand National Airways Corp.* has been completed. The new corporation is operating a route network of some 2,000 miles, over which its fleet of 27 aircraft fly some 8,500 aircraft miles daily.

● U. S. A. : Testifying in connection with the *All-American Flag Carrier Bill,* Juan T. Trippe, President of Pan American World Airways, stated that failure to merge the American overseas airline companies would cost the State $ 100,000,000 a year in subsidies and would result in an annual loss of $ 60,000,000 worth of overseas air traffic. He claimed that a merger as proposed in the Bill would raise air traffic from its present level of $ 150,000,000 to $ 540,000,000 annually, in the space of a few years. — The *20 American domestic airline companies* have indicated a net operating loss of $ 5,675,615 in 1946, compared with a net operating profit of $ 34,116,761 in 1945. — After June 1st, the *USAAF will forbid commercial aircraft to land at its bases* except in cases of emergency. — On June 10th, the U. S. Civil Aeronautics Board will introduce *new regulations for non-scheduled airlines ;* companies will be classified as *"irregular air carriers,"* and entitled to transport passengers and freight within the U. S. A. and between American possessions, but only allowed to carry freight to and from foreign points ; or as *"non-certificated cargo carriers,"* which may only carry freight, and then only domestically in the U. S. A. or between the U. S. A. and its possessions, — *Trans World Airline* has developed a *new airborne radar instrument* weighing only 16 lbs. ; it indicates obstacles within 3,000 ft. by illuminating an amber light, and obstacles within 500 ft. by illuminating a red light and sounding a horn. Howard R. Hughes, chief shareholder in TWA, will have the airline install this equipment in all its 114 aircraft within a few weeks.

● CANADA : *Canadian domestic airlines* carried 620,000 passengers, 4,600,000 lbs. of mail and 24,000,000 lbs. of freight in 1946. During the year, the Air Transport Board of Canada granted licenses to operate air services to 121 applicants. — *Canadian Pacific Airlines* carried 16,514,000 lbs. of cargo in 1946, mostly consisting of supplies for mining development. — A new Canadian company, *Airspray Ltd.*, has been formed to operate helicopters for pest control.

● *Air France* has supplemented its two daily return flights on the London—Paris—Nice route with two weekly round trips between Paris and Nice ; since May 8th a fifth round flight has been made on week days on the Paris—London service.

● *Lancashire Aircraft Corp.*, a British non-scheduled airline, has concluded an agreement with *Airone S. A.*, the Sardinia-based Italian airline, for the transport of Italian products to England in Handley Page "Halifax" converted bombers.

● Due to shortage of personnel the *Royal Air Force* has withdrawn the use of its ground facilities at various bases in the Mediterranean area for civil aircraft.

● AIRPORTS : Howard S. Cullman, Chairman of the New York Port Authority, has stated that *Floyd Bennett Field* should be opened to airline operations by August 1st. — Of the proposed Belg. Fr. 1,275,000 allocated for the development of *Brussels-Melsbroeck Airport,* Fr. 75,000,000 have already been used ; additional part credits of Fr. 182,000,000 are projected for 1947. — The *Union of South Africa* is proposing to spend £ 1,000,000 on telecommunications in the next two or three years ; equipment will be installed in the new national airport in Kempton Park outside *Johannesburg* and at *Durban* and *Cape Town.* — *Heston Airport,* the well-known pre-war civil airport near London, is to be closed ; owing to its being only 1½ miles from London Airport (Heathrow), it cannot be used with safety.

AIRLINE PERSONALITIES

● *Trans World Airline* has appointed *Mark M. Barkan* as its *European Manager of Public Relations,* and *Ronald Duckworth* as *Controller of the European Region, International Division.* — *Air France* has appointed the well-known service and commercial pilot, *M. Casse,* son of the late Director of Civil Aviation in the Air Ministry, as its *Chief Pilot.*

SERVICE AVIATION

● The *first USAAF unit to be equipped with Republic P-84 "Thunderjet"* single engined jet fighters will be the *Air Defence Command's Fourteenth Fighter Group ;* it will be supplied with the first of 83 of these aircraft this summer. Eight thousand workers are engaged on "Thunderjet" production at the Republic plant.

● The *USAAF* is to build a *new heavy bomber base* in *Aroostook County,* Maine, four miles west of the Canadian border, at a cost of $ 14,000,000. The base at *Mile 26,* near Fairbanks, Alaska, is to be developed at the cost of $ 8,150,000. Another Alaskan base, *Shittier,* near Anchorage, is to be developed at a cost of $ 3,000,000.

● The *Pacific Division of the USAAF Air Transport Command* carried out approximately 20,000 separate flights across the Pacific with Douglas C-54 "Skymasters," flying *460,192,553 passenger miles without suffering any accident.* Scheduled flights are made from California to Tokio, Manila, Shanghai and Peking and to Alaska.

● A plan has been evolved for a *Royal Australian Air Force peace-time establishment* of 11,900 officers and men ; such an air force would cost £ 12,500,00 annually.

● The South African Department of Defence's scheme for a *South African Air Force Reserve* has had such a poor response that it has been postponed until next year, when it will probably have the co-operation of private flying clubs.

● The *Norwegian Air Force* has acquired 72 Vickers Supermarine "Spitfire" fighters, 18 de Havilland "Mosquito" fighter bombers, 20 Airspeed "Oxford" twin-engined trainers, from the *Royal Air Force.*

● The *Swiss Federal Government* is asking Parliament to authorise the purchase of *75 de Havilland D.H. 100 "Vampire"* single-seater jet fighters for Swiss Fr. 52,500,000, ancillary VHF ground radio stations for Sw. fr. 3,000,000, and cannon shells, rocket projectiles and bombs for Sw. fr. 8,950,000. The total sum of Sw. fr. 64,450,000 is to be provided for in the Budgets for 1947 and subsequent years. Regarding the acquisition of *another series of service aircraft,* it is being considered whether to buy abroad, acquire foreign manufacturing rights, or else to develop a jet fighter aircraft of Swiss design ; a Swiss jet fighter project has been started, but is being delayed by lack of personnel. At the beginning of May the U. S. Government stated that it will be unable to supply 100 North American P. 51 "Mustang" fighters from U. S. Army surplus stocks to Switzerland.

● The *Italian Air Force Administration* has already abandoned 73 airfields and plans giving up another 90, thereby saving Lire 14,500,000 in maintenance costs and freeing 2,520,420 acres of land for farming.

● On May 6th the 18,300-ton light fleet carrier *H. M. S. "Albion"* was launched at Wallsend-on-Tyne, near Newcastle. The launching of a sister-ship, *H. M. S. "Centaur,"* was reported in the May issue of this magazine.

MILITARY PERSONALITIES

● *Lieutenant-General Hoyt S. Vandenberg,* Director of the Central Intelligence Group, has been appointed to succeed the retiring *Deputy Commander and Chief of Air Staff of the USAAF,* Lieutenant-General Ira C. Eaker.

● *Air Vice-Marshal Thomas Melling Williams* has been appointed *Commandant of the Royal Air Force Staff College, Bracknell.*

PRIVATE FLYING

● The *Fédération Nationale Aéronautique,* the association of French aero clubs, convened in Strasburg from May 1st to May 4th and re-elected *Robert Donne,* Commercial Manager of SNCA du Sud-Ouest, as *President ;* he was recently promoted Commandant de la Légion d'Honneur.

● RECORD : *Count Carl Gustaf von Rosen,* the Swedish Commander of the Ethiopian Air Force, established a new *international distance record* for light aircraft with a cylinder capacity between 4 and 6.5 lit. when he flew from *Stockholm-Bromma to Addis Ababa,* Ethiopia, (3,865 miles) in 30 hours 52 min. ; he bettered the previous record by some 700 miles.

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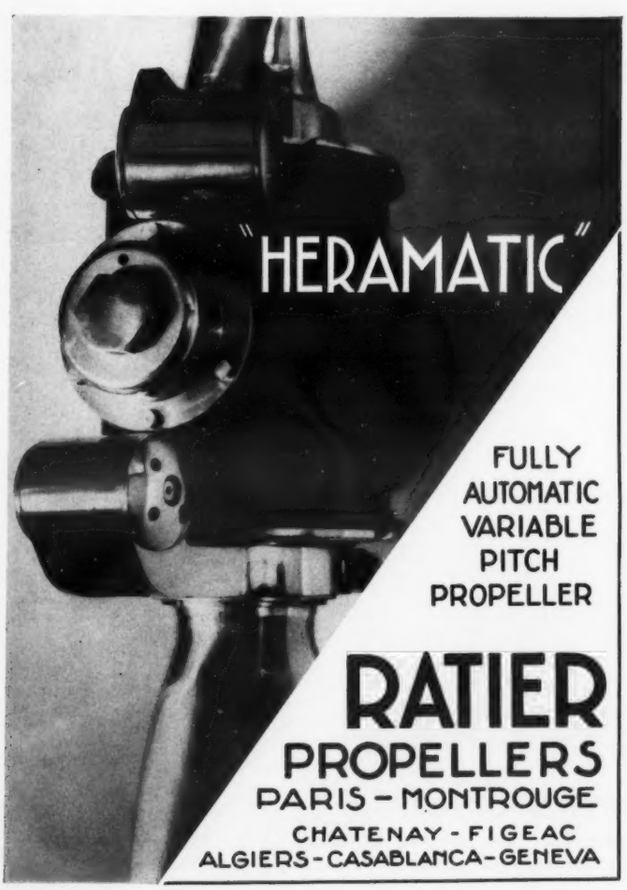

His Royal Highness, Prince Bernard of the Netherlands, insisted on personally taking the controls of the *Ercoupe* on the occasion of the re-opening of Ypenbourg aerodrome on May 16th, 1947.

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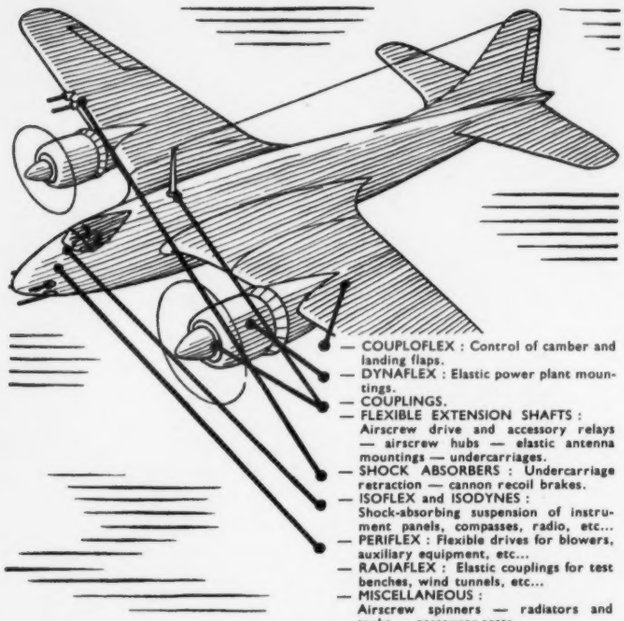

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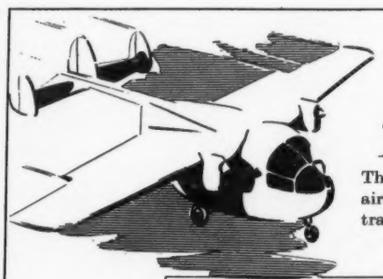

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